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DISCUSSION

THE TYPHOID TOLL[1]

By George A. Johnson

Mr. George A. Johnson: It is about time we all realized that as they now are constituted, and as they now operate, health departments are not all that they are cracked up to be in many things, and that they should be given more moral and financial support in order that they may become more efficient. Also, the personnel of many such departments is capable of liberal improvement.

Sewage treatment is of course an aid in minimizing typhoid; but it is pretty generally recognized by sanitarians as a class that sewage treatment can do no more practically than to minimize the potential dangers of water pollution. It usually is aimed chiefly at the proposition of rendering sewage less offensive. So far as effecting the complete destruction of bacterial life is concerned sewage treatment is a dismal failure. It cannot be done reliably three hundred and sixty-five days in the year by any practical method, consequently we have to recognize that a certain amount of dangerous water pollution is inevitable.

All surface water should be filtered. We learn from statistics that following filtration of the public supply there has been a consistent reduction in the typhoid fever death rate ranging between 65 and 95 per cent, the average being around 75 per cent. This measures the reduction in the total typhoid death rate in the community; it is not a true measurement of the amount of water borne typhoid eliminated by water filtration; if such a measurement were possible it would probably be shown to be nearly, if not quite, 100 per cent.

Up to this time the speaker has not mentioned the Hazen theorem, namely, that where one death from typhoid fever has been avoided by the use of better water, a certain number of deaths, probably two or three, from other causes, have been avoided.

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[1] Published in June, 1916, Journal, Vol. 3, No. 2, at pp. 249–326.

Thousands of lives are sacrificed and millions of dollars in vital capital thrown away every year by inattention, aye, indifference, to these matters. The City of Pittsburgh is a fair example of such indifference to absolutely indubitable facts. That city struggled along for years with the highest death rate from typhoid in this country. A typhoid death rate of 130 per 100,000 was common, and for over thirty years it averaged more than 100. Then they built a filter plant, and what happened? Pittsburgh today has about the lowest typhoid death rate of any large city in the country, and wholly through a purer water supply avoids nine thousand cases of typhoid annually, and saves $4,000,000 in vital capital each year.

Mr. J. M. Diven: Mr. Johnson has given us in compact form information that it would take the ordinary water works superintendent months and years to hunt up. He has given us just the kind of information that we want to lay before water committees, members of city councils, etc. By his strong presentation of facts with reference to water pollution and the necessity for remedying it, he has filled a long-felt want.

Mr. Paul Hansen:[2] Mr. Johnson's paper is the most complete, readable and interesting in point of view that has ever come to the writer's attention on the subject of typhoid fever. The facts are presented so significantly that the paper may well constitute a model and a mine of information for health officials who wish to place the typhoid problem, as well as other health problems, before their respective publics in a way that will make them sit up and take notice.

Under the heading "Health Department Inadequacy," Mr. Johnson discusses in a telling and picturesque way the shortcomings of health departments as they now exist. Every word of this is true, though in many of the smaller communities conditions are far worse than Mr. Johnson has described, primarily because health officers are employed only on a part time basis and at a paltry salary. The speaker knows of instances where health officers are paid the munificent sum of but $5 per annum, and sums of $30 to $50 per annum are not at all unusual. Naturally such an officer does not care to alienate any of his private practice as a physician from which the bulk of his income is derived, and, therefore, it is not to be wondered at that he is remiss in enforcing the law.

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[2] Chief Engineer State Board of Health, Springfield, Illinois.

Most sanitarians have a very clear idea of how an effective local health department should be organized, paid and conducted, but they also realize that it is out of the question to secure the right kind of a health organization at once. It is universal experience in health activities that the only way results can be obtained is to concentrate effort on one thing at a time. This was the policy pursued with reference to the improvement in public water supplies, which Mr. Johnson so strikingly relates and records. So in the case of securing better health administration, we must move one step at a time, and the all-important step to take at the present time is to secure the employment of the full time health officer. The full time health officer will not, of course, entirely solve the problem of health administration, but he will carry us a long way in the right direction. Once the full time health officer is recognized as a necessary institution, those interested in the promotion of health can work for the elaboration of the health department organization. For the present, at any rate, no greater service can be performed in the interest of public health than to urge in season and out of season, the employment of a full time health officer.

Mr. Johnson in the course of his discussion makes some pertinent remarks on the nonobservance of sanitary law, and he might have added that this is in large measure due to the fact that many sanitary laws are poorly drawn, unnecessarily severe, inconsistent as between various communities and various states, and often far in advance of what the general public will stand for. Societies like the American Public Health Association should give attention to the codification of sanitary laws so that there may be greater uniformity of practice.

In connection with certain state sanitary laws relating to the activities of engineering bureaus, a tendency exists to make such laws altogether too lengthy, too drastic, and to include in them too much of the unessential. Too much stress can not be laid upon the necessity of drawing up sanitary legislation with great care so that it will be practically enforceable and will not exceed that which will have the backing of public opinion, for after all, we live in a democracy, in which the government cannot be ahead of the people. To express the situation somewhat differently, a health department should educate its public to the need of the law before attempting to introduce the law.

In discussing the control of state boards of health over installation of water supplies, water purification works, sewerage systems and sewage treatment works, Mr. Johnson proposes that state boards of health should not be given power to review plans, but should be required to approve any scheme for water purification and presumably also water works, sewerage systems, and sewage treatment works that are "tangibly guaranteed", whatever that may mean. In the first place, engineers who design works of this character are not in the habit of guaranteeing that their designs will work properly, nor are clients in the habit of demanding such guarantees. In fact, it would generally be considered unprofessional. It then appears that the guarantee must be made on the part of the contractor. This would certainly be unfair when the contractor is bidding upon an engineer's detailed plans, and in most classes of sanitary engineering works it is necessary for the engineer to prepare his plans in detail. An occasional exception to this is current practice in connection with the installation of water purification works. Engineers frequently draw their specifications so that filter contractors can bid on their own plans and specifications for a part or the whole of the work, but as this is not the universal practice, and as water purification works represent only one class of engineering works that must be reviewed by state boards of health, Mr. Johnson's proposal would not seem to be practicable. Furthermore, allowing that it would be possible in every case to secure "tangible guarantees", every engineer knows that such guarantees are often not worth the paper they are written on. In no field has this been more evident than in the water purification field, for it is well known among engineers that a poorly designed, crudely constructed filter plant can be made to furnish a pure water during periods of trial tests and under skillful manipulation though similar results cannot be expected under ordinary operating conditions. Certainly, Mr. Johnson would not propose tying the hands of the state boards of health so that these boards cannot head off such practices as this.

A proper check on possible mischief on the part of state boards of health which do not have competent engineering advice is to have the law so framed that any municipality, corporation, or institution which has occasion to submit plans to a state board of health and which may not regard the requirements of the board as correct or just, can demand a reference of the matter to a commission of expert sanitary engineers to be appointed and employed jointly by the state board of health and the party taking exception to the board's orders. Such a plan has been adopted in part in the state of Ohio and has worked well to the extent of its applicability.

MR. ALLEN HAZEN:[3] The speaker wants to commend Mr. Johnson for this statement of the development of water purification and the effect upon the public health. In that connection it may be not amiss to point out that it is only twenty-four years since the first water supply was purified in the United States with the deliberate purpose of reducing the death rate. The water supply of Lawrence, Massachusetts, is referred to. The filter for doing this was designed by Mr. Hiram F. Mills, and the speaker was fortunate enough to be connected with its construction.

Though a young man yet, the speaker has in his short life seen the whole of this wonderful development that Mr. Johnson has described.

It is only a little more than twenty years since we began to talk much about these wonderful possibilities of reducing the death rate by purifying the water supplies. Mr. Johnson will bear out the speaker that the results that have been so far reached have fully justified the prophecy then made and which some of you thought was rather wild at the time. The horrible condition of filthy water and high death rates that ought to have gone with the middle ages and which still did exist twenty-five years ago in the United States, has been eliminated; but there are a great many untrimmed corners yet. There is a great deal of work yet to be done in cleaning up places that have been passed by in the main development.

It may be some time before it will become necessary to treat all the remaining waters that Mr. Johnson spoke of; because when you get a water supply in the Sierra or Cascade Mountains without a human habitation on the catchment area, it is going to be some time before the people will put up money to filter that water, and conditions approaching that exist in quite a number of the remaining unfiltered public supplies of this country.

In that connection the development in the disinfection of water by chemical treatment, in which development Mr. Johnson played an important and creditable part, has resulted in the cutting down of the typhoid rate in communities supplied with waters where conditions are not very bad, and which has particularly made it possible in connection with filters to turn out a water practically safe from a typhoid standpoint.

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[3] Consulting Engineer, New York City.

When the movement for filtration once got going filter plants were built in large numbers. Many of these plants were excellent in design and construction and were efficient, but it is also true that there were others that were and are inferior and hardly deserve to be called filter plants, and these have been built in altogether too large numbers in this country. These plants could not stand up to the service that was demanded of them or turn out the kind of water that is necessary to reduce the death rate to a minimum. In bracing these plants up chlorine and other processes of that kind have played a very important part; and by their aid fair results have been obtained with many badly constructed plants, but the gradual reconstruction of many of these inferior plants is to be expected.

Mr. Hansen deserves to be most cordially commended for what he has said about guarantees. Nothing is more misleading in water works practice than guarantees of efficiency of a plant. It is not necessary to enlarge on that, though the speaker could talk from personal experience for hours on that one point. Mr. Hansen has made the point very well.

MR. W. E. MILLER:[4] The speaker has read Mr. Johnson's paper with a great deal of interest, and regards it as extremely valuable and instructive. There is one thought it suggests that may be worthy of mention here and that is, that some of the ideas that Mr. Johnson has given us ought to be matters of common knowledge, universal knowledge, particularly with respect to the various methods of transmission of typhoid infection. It is going to be very difficult to get boards of health, local or state, to bring about such a complete dissemination of that knowledge as could possibly be done in another way. It seems that the most effective way of widely disseminating some of those ideas is to incorporate them in our system of education. It does not require any study of medicine; it does not require any great amount of time to be devoted to the subject, or the exclusion of work now given; but some of those ideas ought to be given to children in the public schools, if that is not already being done. There is nothing to prevent us from getting outside of our shells as water works men or as engineers and directing our efforts as public-spirited citizens in the way of urging and demanding the instruction of our children as to the primary precautions that should be taken toward stopping this great and needless waste of human life. There is no better way to do it than to give instruction to our children in the public schools regarding hygiene and sanitation.

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[4] Madison, Wisconsin.

Mr. Louis L. Tribus:[5] The speaker sent in a brief written discussion so will not go over any of the ground taken in that. The last speaker has hit upon the practical key-note to this problem. Those of us who have had to do more or less with municipal development, particularly along sanitary lines, have known and have appreciated that it was our duty to try to arrest the danger arising from insanitary conditions due to water pollution, and due to possibilities of danger even where we did not see it, through educational campaigns.

Mr. Johnson's paper has given us perhaps the best compilation and the best presentation of this subject that we have had to date. It contains a great amount of information from all over the field. It is necessary to impress the powers that be to appropriate moneys, not alone from the standpoint of dollars and cents, although that may well be conclusive, but from the moral side also we must impress the grown people and the children over whom they exercise authority with the existence of these dangerous conditions.

We are all of us familiar with the fly crusade. Few realized what a serious matter the fly danger was; but facts were gathered and presented throughout the country. At first these were laughed at; but when additional proofs were presented so that the people could not deny their truth, and convincing pictures of flies alighting on piles of filth, then on the top of the milk bottle, and so on, or passing from stable to table, people began to be impressed with the fact that disease could be transmitted in such ways and then they began to act. We ought to have all of this class of information in such shape that the children will take it in, then their parents will follow, and city and state officials will quickly get into the procession towards duty well done. This is reversing the time honored ways of education, but it is the best practical way today.

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[5] Consulting Engineer, New York City.

DR. D. P. CURRY:[6] It is frequently asked why it is that the State Board of Health is not located at the State Capital of Kentucky. The most effective answer is, because our State Board, located where it is in the West Kentucky State Normal School, is in daily contact with three thousand of the future teachers of Kentucky. We know many of them by their name, and they know us rather intimately after several years of contact. So that as the speaker drives out through a remote mountain road in Kentucky past a country school the teacher will run out and call him, saying, "Dr. Curry, stop and tell my children something." We come into personal contact with our future teachers, and that is going to mean a great deal to the generation they are to instruct.

Mr. Johnson touched upon our greatest problem when he spoke of rural communities. Water works men are doing much to improve the general health of the public, but their efforts are mainly confined to large cities. You must think more about sanitation in the country, both village and farm, if your efforts are to reap the greatest recognition. Even in New York City this applies. You can reduce your typhoid rate to the minimum and there remains that residual rate which is so hard to diminish and to locate the source of. Let it be due to milk, carriers, flies or other agencies, you will still find people pointing a finger of suspicion at the water supply. They may languidly swat a few flies, but the business of swatting a water works commissioner is much more alluring. It takes an expert to swat a fly, but anybody can reach a water commissioner and he cannot prove an alibi in the winter time.

But you can assist in spreading the gospel of sanitation to all mankind. The Kentucky State Board of Health has devised a sanitary privy that you should be interested in. It will solve the question of an occasional surface privy upon a water shed; it will improve sanitation upon the dairy farm and reduce your milk borne infection; it will make more clean your summer resorts and camps and make these places more in fact, than as now, in name only, health resorts. And the city profits by having these many avenues of infection stopped.

The Kentucky Sanitary Privy has been improved in design until now one can be built for a cost not exceeding ten dollars for materials in favored localities. It is odorless and costs nothing to operate. It practically never has to be cleaned out. In seven thousand installations in Kentucky a case of disease resulting from its operation has never yet been discovered. It is known that one or two had to be cleaned out, and that was because they had been used as receptacles for empty whisky bottles. Our department has issued a little bulletin on this subject, and there are twenty-five thousand of them now in the hands of the public printer of Kentucky. The drawings and descriptions are so simple that any school-boy can read them and build one of those privies. In connection with it there is a small septic tank of 200 gallons capacity. It only takes about 5 gallons of water a day to make it operate perfectly odorlessly. There is an intermittent application to the soil once every twenty-four hours of only 5 gallons of water. The speaker will be glad to send any of you gentlemen a copy of our bulletin. The use of these sanitary privies would go a long way toward stopping rural typhoid fever.

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[6] State Board of Health, Bowling Green, Kentucky.

MR. C. ARTHUR BROWN:[7] It seems that the chief value of Mr. Johnson's paper lies in the fact that he has got his talk over. It does not make very much difference how much a man knows, it is of no value unless he can impart it to others. It seems that in presenting this paper in the way that he has, Mr. Johnson has achieved singular success in putting the matter before us in such a way that he has brought to us the whole idea that he had in mind.

The speaker's work is somewhat peculiar in that he has to cover a very large portion of the country in it, and come into contact with a great many cities where this problem has been up in various forms. The company with which the speaker is identified has done a large amount of work in lines somewhat related to water purification, and it seems that the whole value of a thing of this kind is only attained when we can make every one see and realize the facts as Mr. Johnson has produced them. If we can do that we will have no trouble in getting action by the people through their political representatives. There is, as we know, a very great need of more public pressure to induce officials to do that which they ought to do.

Usually water works men are very aggressive in trying to secure such action from political office-holders in their cities; but the people as a whole do not put their support behind the efforts of the water works man sufficiently to enable him to exert enough pressure to get the officials to do what they ought to do. To give one particular instance where for fifteen years there has been a strong and persistent effort made, and some eight different elections held, trying to get a filter plant for a very impure water supply. There may possibly be three or four more elections before final action can be secured. Why? Because the people themselves have not had the facts placed before them sufficiently strongly and clearly to impel pressure on their part.

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[7] Sanitary Engineer, Lorain, Ohio.

This paper by Mr. Johnson is going to be of tremendous value in enabling those interested to create a better public knowledge of how to do it more efficiently than they otherwise could. Mr. Johnson has taken one position on the health board proposition, and Mr. Hansen a somewhat different position. It would appear that the proper solution is going to lie perhaps somewhere in between. The State Board of Health officials have in the past approved plans for purification plants that were not what they should have been; and on the contrary, they have at times condemned plans that were better than those that were finally adopted. There is, therefore, a certain amount of justification for Mr. Johnson's contention that state boards of health should not, after all, be the sole authority in approving or condemning plans of reputable engineers; on the contrary, a great many plans have been submitted which the state board of health have killed because they were not adapted to do that which they contemplated. In this respect the state boards have exercised proper authority and have been very useful.

Mr. Hansen has referred to the state law of Ohio, which is perhaps one of the most progressive in the country; but even under those conditions evils have arisen and plans have been passed that should not have been passed. It is true that a large number of inadequate plans have been adopted and better plans condemned; and it seems that this Association might take up with considerable profit the harmonizing of the extreme views upon this subject, and bringing together the men interested so that they might ultimately work out a solution of the matter that would be better than anything which we now have.

Mr. Hansen also referred to the statement that the operators of the plants under official test conditions can produce or did produce results which the city was thereafter hardly ever able to maintain. Why? Simply because the same amount of brains was not applied to the problem; that is all there is to it. When a contractor builds a plant and that plant upon completion is subjected to a test, the contractor finds the best man that he can get to place in charge of it and operate it during the test period; and that man produces results so that the contractor makes good his guarantee in the vast majority of cases; because ordinarily a wise contractor knows that he can perform his work before he makes any guarantee. Now if the city were to follow the same plan and put capable men in charge of the plants there would be far less complaint about such plants failing to perform their functions. A good plant in the hands of a poor man may be infinitely less efficient than a poor plant in the hands of a good man; entirely too little thought and emphasis have been laid upon that proposition.

SECRETARY DIVEN: A question for Mr. Johnson to answer has been handed in: "Is it permissible to discharge the effluent of a sewage disposal plant into a stream, even when the water in that stream is eventually to be filtered?"

MR. GEORGE A. JOHNSON: This is a matter which is receiving the earnest consideration of certain state boards of health at the present time. The speaker has always taken the position that a certain amount of pollution of public waters is inevitable and unpreventable. Where sewage treatment works have been installed on a watershed it frequently has been for the purpose of producing an effluent as innocuous as possible, but more often to render the sewage before discharge into the stream as inoffensive as local circumstances required. Thus the stream would digest without nuisance more of the purified sewage than it could of raw sewage.

The question propounded is a highly debatable one, but personally the speaker is willing to express the profound conviction that it is permissible to discharge sewage effluents into running streams or other public waters, provided that in the selection of the point of discharge due consideration is given to nearby water works intakes and public wells; and also provided that the raw sewage is first purified by processes necessitated by local conditions, and that the treatment works are operated as efficiently as climatic conditions and the state of knowledge in the art of sewage treatment will permit.

The speaker believes this to be a thoroughly tenable position. He also believes that to try to prevent the discharge into public waters of a sewage effluent from a plant which has been built in accord with the best modern practice, and which is efficiently operated, is to attempt the enforcement of an unconstitutional premise. The only remedy is the filtration of all surface waters.

MR. THEODORE HORTON:[8] This is a most vital subject and a remarkable paper for which the author deserves a great deal of credit.

By a coincidence the speaker happens to have come from a conference of health officials of the State of New York held at Saratoga Springs, and to have incidentally presented a paper two years ago on the elimination of waterborne typhoid fever in the State of New York. Owing to the prominence of this state in the entire country it might be interesting to know what we have done to eliminate typhoid fever. It bears on a number of questions that have been brought out in Mr. Johnson's paper. For that reason the speaker feels in duty bound to give you these facts.

The typhoid fever curve for the State of New York is divided into two periods; an earlier period prior to 1906, and a later period subsequent to that year. The characteristic of the curve prior to 1906 is an excessive rate averaging about twenty-three. There is no uniformity to it. It ranges from eighteen to as high as thirty deaths per 100,000. The latter period from 1906 to 1916 is characterized by a comparatively low rate, averaging about 12.3, which is about one-half of the rate for the previous period. The rate for last year was 7.4.

Another feature of that curve is that it is practically a straight line from 1906 to 1916, so straight that there is practically no deviation to it, which means that there will be practically no typhoid fever in the state if the curve keeps on decreasing; which of course being an impossibility, arouses a very interesting question as to what will be the future rate of typhoid in the state. It will probably ease off very rapidly so that the curve will strike a horizontal position which will represent the residual typhoid in the state. What is it that occurred about 1906 that made this great difference, and which accounts for this lowering of the typhoid rate since that time? The first reason would be the change in the law. In 1903-1904 the law was changed to give the state health commission greater powers over the pollution of streams; a more important feature, however, is that in 1905 the health department was entirely reorganized. In 1906 an engineering division was established. Prior to 1906 there were practically no investigations made of the water supplies in the state, and nothing systematic in that direction was done, although a great many promises had been made.

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[8] Chief Engineer, State Department of Health, Albany, New York.

So far as water supplies are concerned, prior to 1906, or at that time, there were something like 6,000,000 people supplied with water in the state out of a population of 8,000,0000 or 9,000,000. In 1916 8,000,000 people were supplied.

The number of people in 1906 that were being supplied with purified water was 700,000, in 1915-1916, 6,700,000. In other words, in this latter ten year period the number of people with protected water has increased from 700,000 to 6,700,000, or an increase of approximately 1000 per cent. In percentage of the entire state population it represents an increase from 10 per cent in 1906 to 70 per cent in 1916.

Mr. Johnson's remarks in regard to the state boards of health are presumably meant to be general. So far as the inefficiency of a great many of them is concerned, when we consider the work that our departments have done since their inception, it seems that their efforts have proven that the state departments of health can do considerable along this line.

There are 500 water supplies in the State of New York; 400 of them have been thoroughly investigated. Last year 150 were investigated and by the end of this year the investigations will be completed and a report on practically all the water supplies of the state will be made. These reports are invaluable not only to the department but they are invaluable also as a means of inducing local officials to educate the public to the point where they will bring about the improvements that are recommended. The reports are based upon the studies and investigations, and give full conclusions and recommendations. Following up these recommendations is the work of the sanitary supervisors and local health officers.

The local health officer deals largely with the residual cases of typhoid fever, whereas the state department deals largely with waterborne typhoid. When it is realized that 67 per cent of the total typhoid due to waterborne causes in this state has been cut out in the last ten years it will be understood that in the future the residual cases will have to be largely dealt with, as it will not be possible to make a very much greater further reduction in the elimination of waterborne typhoid.

MR. DANIEL D. JACKSON:[9] Mr. Johnson's paper is of wonderful interest, as has also been the discussion thereof. The paper itself is a classic in that type of literature, as it covers the field most thoroughly and in the fewest and strongest possible words.

The speaker would like to add something regarding the transmission of typhoid by means of flies as related to water works practice. In the spring of 1898 an epidemic of typhoid fever occurred on the watershed of Brooklyn, on a strawberry farm where, during the short period of strawberry picking, about one hundred laborers were employed and lived in tents. It was found that the open latrine used was the source of the trouble, the water supply and the milk having been thoroughly investigated and found to be good. Powdered eosine, a pink aniline dye, was sprinkled in the latrine, and inside of two hours the pink stains were found on the tablecloth where the men had their meals. This stain had been carried by flies from the infected fecal matter to the dining table. The nearby ponds and streams in this section, which were part of the Brooklyn water supply, were at once shut off and allowed to bypass. One of the upper streams near the farm was afterwards found to be badly contaminated, so that a serious epidemic of typhoid in Brooklyn, which at that time had a population of over a million people, was probably prevented.

Another typhoid epidemic not long ago, which occurred at Bay Ridge, and which was thoroughly investigated, was found to be confined to certain particular sections in which building operations were going on, where a large number of mechanics were employed, and no toilet facilities were constructed; in other words, they used the basement of these buildings as privies. This happened to be in exactly the right period of the year for fly transmission. The trouble seemed to develop in groups, close to the building operations, but there was another bunch of spots on our map of typhoid cases, on the other side of the town, nowhere near the building operations. It was sometime before this problem was solved, but it was finally discovered that in this section the houses were on one side of the street, and on the other were a lot of bushes where there was a very large amount of fecal matter, in many cases of diarrhoeal character. They had been putting in a main trunk line to furnish water to that particular section, and the pipe had just been covered up. They had had considerably over 100 men working there with no toilet facilities at all, and this was the source of the typhoid in that neighborhood.

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[9] Sanitary Expert, Columbia University, New York.

Where any large number of laborers are employed during the fly season this is a very important matter to consider, and is often the source of a typhoid epidemic which may afterwards extend to the water supply. So you see the question of fly transmission is very important, and, in building pipe lines, or other construction work, due regard should be given by water works engineers and contractors to the provision of proper toilet facilities. The Sanitary Code of New York City has since been amended to meet this important condition, and every city and town should make such requirements.

Mr. M. N. Baker:[9] The speaker will reserve for the most part what he has to say for a written discussion; but would like to bring out emphatically one point that was suggested by Mr. Johnson's paper which may well be considered an important point, and that is, when we talk of the appropriations that are made for local health board work, and for state health board work, we should take into account, as the matter stands today, the fact that a large percentage of the appropriations that are made in the name of health is spent, not for health protection, but for things that have nothing whatever to do with the protection of health or the saving of life. Many of the communities which make the best showing with respect to the amount per capita of expenditures for health, and many of the states that are highest in the list in that way, are spending their money for the most part for other things than direct health protection work.

It is extremely essential that the local boards of health and the state boards of health, where they are not already doing it, and where the city is not already doing it, should, so far as typhoid is concerned, direct attention to the causes of typhoid; and having done that, to the removal or prevention of those causes; and take measures that will help to eliminate them, instead of spending so much on bare show, as is being done today.

Mr. Horton has told you one way, so far as the departments of health are concerned, for getting at it, and that is for the engineering division to make a careful study of the water supplies of the state; and when that is done in other States as well, we will doubtless see where the high typhoid rate now prevails and will be able to make efforts toward a material reduction of it.

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[9] Editor, *Engineering News,* New York.

Before the speaker finishes you will see why he has referred to Mr. Horton. It always gives him a thrill of pleasure when he hears Mr. Horton speak. We got him, at Montclair some twenty years ago, to carry on an investigation in our local health board work. We concluded that instead of taking some local doctor of middle age we would pick out a young man who had some enthusiasm in the work and who would take an active interest in it, as the health board had been suffering from incompetent work of incompetent physicians. So we decided that we would apply to Professor Sedgwick, of the Massachusetts Institute of Technology. We did so, and he recommended to us a young man who had been trained in sanitary engineering. From that beginning, and by following that policy, we obtained some remarkable results in the Montclair health board work, and about the same time a number of other communities adopted the plan of taking on engineers instead of health officers for local health board work; and as conditions were at that time, there was no training whatever that fitted men for such work; it was being done by doctors entirely. From that time the custom spread of appointing engineers for local health officers, and that has continued until now there are many cities that have anywhere from one to a considerable number employed. Detroit today has four. Mr. Saville has recently been made Director of Sanitation at Dallas, Texas; and the good work is still going on.

Now with every state board of health it is not, of course, meant to give the engineers the whole credit; but it is largely due to the fact that the engineers with sanitary training have been put to work in connection with state boards of health in the country that we are cleaning up our water supplies and reducing typhoid fever as we are.

PRESIDENT HILL: Some of the state boards of health in this country should try to correlate the responsibilities of those discharging sewage into a stream and those who take water from this stream for drinking purposes. The speaker is impressed by the drastic requirements of some state boards of health with regard to sewage disposal, all of which tends to retard the results to be achieved.

It is not believed that a sewage disposal plant may be reasonably expected to turn out drinking water, but that it should be so designed as to keep our streams in proper condition; that is, to keep them sweet, to maintain the oxygen content in proper proportion, to obviate visual and olfactory nuisances, and to maintain the water in the stream in such condition that the filter plant may handle it with a reasonable degree of care and efficiency.

There is much work to be done in this line if we are to get the coöperation of small communities, factories, mill owners and others who are required to build sewage disposal works and if we hope to accelerate cleaning up our streams.

MR. JOHN J. POWERS:[10] The speaker would like to call your attention to the fact that 800,000,000 people travel on the railroads, and 500,000,000 people travel on the boats of this country, and their excreta are deposited on the highways of commerce along the railroads, or into the waters of the several States. One of the practical things that you could do would be to call the attention of your representatives in Congress to the necessity for preventing the railroads of this country from scattering excreta and infection along the entire course of their roads. Many times men look for the foci of infection and they wonder where it is; typhoid fever appears where there has been no typhoid fever in the neighborhood, or scarlet fever, or diphtheria, and they wonder where it comes from. It may have been blown in by the winds from off a railroad track, having become dried and reduced to dust; or it may have been washed down in the stream by the rain. Mr. Johnson's statement as to the danger of urine pollution is extremely valuable, because nearly every one travelling for any length of time in a railroad car uses the urinal; and also the statement of Mr. Jackson as to what he found practically all along the line where they were laying a water pipe, in the way of surface pollution by men who were not under proper supervision.

MR. RUDOLPH HERING[11] (by letter): Mr. Johnson has given us a very clear and readable paper on the most important facts which relate to typhoid fever from a sanitary engineering viewpoint. For the water works engineer, it is one of the best accounts he has to help him know and appreciate the origin, the spread and the prevention of this scourge.

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[10] Elizabeth, New Jersey.

[11] Consulting Engineer, New York City.

To be of assistance in any direction it is necessary to thoroughly understand our subject; and when this is presented in so attractive and forcible a manner as Mr. Johnson has done, it cannot fail to be of much value. He well points out that the most efficient means with which to combat the typhoid evil is education. No truer words can be said than that "education, respecting health matters, is the light which will eventually lead us out of the insanitary wilderness". In fact, we may say of all troubles that education is the best means for removing or alleviating them.

According to Mr. Johnson's advice this education must extend to both the governing and governed classes, to the city's officers as well as to the citizens. Those persons who are responsible for furnishing a community with a good water supply should keep closely in touch with the latest progress that is being made in this branch of engineering both in theory and practice. But it is even more important that the general public be educated in many matters relating to it, because an ignorant citizen by a single foolish act can do more mischief than many city officers may be able speedily to remedy. We must, therefore, educate both those who control the design and operation of water works so as to prevent the spread of typhoid fever, and also those who use the water and who are sometimes the more responsible for the occurrence of epidemics, because of an innocent ignorance as to how they originate, spread and can be prevented.

It is true that we have now succeeded in preventing much typhoid fever by the proper use of anti-typhoid vaccine. This expedient may become in time as valuable as the anti-smallpox vaccine, but this expectation must nevertheless not hinder us from imparting the education now practicable regarding the dangers that face us and how they can be avoided. Such education will help at once.

The writer trusts the time may not be far distant when all surface waters will be purified before they are delivered to consumers, and when no waters will be delivered in a natural state, except spring or ground water which nature has herself purified.

The cities in most of the western countries of the European Continent have for many years adopted this rule, and it has been very effective in reducing and almost exterminating typhoid and many diarrheal diseases. Let us hope that in our country we will also soon rise up to the same level of civilization, and supply our citizens with none but either pure ground or spring water or, if these are not available, with purified surface water, and not subject them to the danger which might come from the 20,000 typhoid carriers, mentioned by the author as living in the United States, one of whom can, by an innocent but improper act along the banks of any water supply brook, produce a typhoid epidemic in the town below.

Dr. George A. Soper[12] (by letter): Mr. Johnson's paper is an eloquent plea for a clearer understanding of the typhoid peril and of the part which the filtration of public water supplies may take in reducing it. He says that the typhoid rate, which averages 20 per 100,000 in American cities, can be reduced to 14 by filtering the water supplies which are not already filtered, and that this would cost about $100,000,000, which is equivalent to an annual expenditure of about $12,000,000. These figures are understood to be rough approximations and are given to illustrate the part which filtration can play in eliminating one of the most familiar and costly diseases. Speaking generally, it can be reduced about a quarter.

Mr. Johnson could have made out a stronger case for filtration if he had cared to set forth its other advantages. He could have shown that the general death rate, as well as the typhoid death rate, generally falls when filters are put into service and that the cleaner, clearer, brighter water which is supplied produces many benefits some of which have a large money value. Accurate estimates of these advantages are impossible, but it is not unreasonable to suppose that the aggregate money returned to a town from the installation of filtration works greatly exceeds that represented by the saving in lives from typhoid, large as that is.

The author of the paper has performed a public service by frankly acknowledging that the capacity of filters is limited in reducing typhoid. Certainly they cannot prevent more cases than the water supply can produce. Some persons will be disappointed to find him saying that the disease cannot be eliminated altogether by filters, but the paper shows clearly why this statement cannot be made.

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[12] Chemist and Engineer, New York City.

In making what some will regard as a low estimate of the amount of saving possible, the author of the paper places himself fairly in line with recently ascertained facts. There has recently been much progress in the study of typhoid. More has been learned in the last few years of the causation of this disease than had been found out in all the time since it was first recognized.

The most important fact to remember is that typhoid is essentially a contagious disease. It is only incidentally a water borne disease. Its germs live perpetually in the bodies of some persons who are otherwise in perfect health, and no medical treatment thus far devised can exterminate them. In any community there are generally more persons in seeming good health who are producing typhoid germs than there are patients suffering in bed from the disease. From these living and moving centers the germs radiate in various directions. The usual means of transmission are short and direct. The germs are literally handed from person to person. Nurses commonly perform this office. The bacteria, fresh from the body of one person get onto the hands and so to the food of another. This is close range infection, the most dangerous and perhaps the most frequent cause of typhoid fever.

So common is the occurrence of close range infection that it is always wise to seek a strictly local cause in an outbreak of obscure origin. Upon this principle many epidemics have been accounted for, including the historic outbreak in which Typhoid Mary was discovered.

In spite of the notoriety which has attended certain aspects of the Typhoid Mary case, the history of that unfortunate woman has never been told to water works people with that accuracy and fullness which is desirable, and this is not the time to tell it. It is sufficient to remark that, contrary to the opinion of some, this person has never been exploited for the benefit of others, but has brought upon herself a large part of the public attention which she has received. Finally, upon securing her freedom from the New York City department of health, she went back to her former and fatal occupation of cooking and produced a number of fresh outbreaks, one of which, in a hospital, led to her second arrest and present detention by the health authorities. Aside from its being the first instance of a typhoid producer discovered in America this case is interesting for the way in which it was handled by the department of health and the complete justification which the subject has herself given for her unusually severe treatment.

The paper which we are discussing calls attention to some remarkable peculiarities about the incidence of typhoid which have always puzzled those who have sought to explain them, and which, in spite of some excellent recent work, still appear as difficult to account for as they ever did. One of these is the seasonal distribution of typhoid. Another is the preponderance of the disease in rural as compared with urban districts. A third is the excessive rate among the colored race. A fourth is the large amount of typhoid in the southern as compared with the northern sections of the United States. A fifth is the surprising way in which the rate may fall in seeming response to a sanitary improvement which otherwise appears to have nothing to do with it. The explanations of these phenomena given by Mr. Johnson are probably as good as any which could be offered at the present time, but none is completely satisfactory. They should be regarded as sufficient only until more facts are collected and more definite conclusions drawn. It is in this sense that they appear to have been put forward. It may satisfy the imagination to ascribe real danger to cheese, butter and fresh vegetables, but there is a regrettable dearth of information actually establishing these possible means of transmission as real dangers.

If typhoid fever is to be eliminated, it must be by seeking to reach the germs not alone by such long range measures as filter plants, but by measures close at hand. Especially should an effort be made to reach the germs at their source. It must be recognized that they breed in people, rarely in things. These people must be found and surrounded with effective, though not irksome precautions. This has been done abroad and can be done here. It is essentially the work of the health officer, the nurse and the physician. Above all, it is the duty of every person who has had an attack of typhoid to ascertain whether he has become a carrier, and if so, what he should do to protect others from contracting the disease from him.

It is noteworthy that Mr. Johnson has merely mentioned what is probably the firmest defense which the individual can provide for himself, vaccination. Anti-typhoid inoculation affords a well nigh impregnable defense against typhoid. It is compulsory now in all the armies of Europe except that of England. Its protective effect among our own troops has been abundantly shown.

In conclusion, the question may fairly be asked: what is to be the final result of all the work which is being done for the elimination of typhoid? Can it ever be utterly exterminated? Nobody can give an authoritative answer to this query, but those who are best informed hold the view that typhoid like typhus and other filth diseases with which it was once associated, will disappear from the civilized parts of the world under normal conditions of peace and prosperity to reappear only under conditions of exceptional social stress. Better regard to cleanness and order, to nourishment, rest, recreation and intellectual enlightenment, has driven most of the pestilential diseases from most countries, so that even the names of some are not recognized in those places where they once brought terror.

But repeat the conditions of life in which cholera, plague, typhus and typhoid were once rampant, and nothing but the most heroic efforts of science can keep them down. This fact has been well demonstrated by the remarkable thoroughness with which the Germans have fought typhoid in the present war, and by the alarming outbreaks of typhus and other contagious diseases which have occurred where adequate precautions against them have not been taken. Peace brings no greater blessing than the opportunities it offers for the progress of civilization, and war has no consequences so disastrous as the impediment which it offers to that progress.

Dr. William H. Park[13] (by letter): Mr. Johnson's paper covers a most important subject and does it in a very comprehensive way. Until lately all of us felt ashamed of our typhoid death rate. The record of the last ten years shows splendid progress, but, still, as Mr. Johnson shows in his paper, much remains to be done. Undoubtedly water is the chief danger and milk the next important one. If the public can only be brought to appreciate the amount of sickness still caused by infection carried in water and milk, and that it can be so absolutely prevented, it seems as though a demand must arise that all water and milk used for drinking purposes be rendered safe.

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[13] Pathologist, Health Department, New York City.

The members of the American Water Works Association have done splendid work in rendering much of the water supply of America safe, and the writer hopes they can see, in the near future, no water supply consumed while still unsafe.

MR. JOHN A. VOGELSON[14] (by letter): The author has gone so thoroughly into the subject that the only points that could be discussed are those relating to devising practical means for reducing the "Toll", and here, it seems the attainment of the desired end is through a thoroughly awakened civic conscience, which will not permit the doing of those things which are proven harmful to public health.

Referring to Mr. Johnson's quotation from Dr. Freeman that typhoid is now "a problem of administration", probably that expresses the situation concisely in so far as governmental activities are concerned, when administration is used in a very wide sense to collectively express all acts of government, legislative, executive and judicial, in dealing with this problem, and not to the detail of some particular branch of the executive function. For all of the functions cited are inseparable, and some of our errors arise in not giving due weight to the function with which we are not directly associated.

Health administration in its practical application is in large part the restraining of people from committing harmful acts, and those acts, in many instances, are the outgrowth of customs which, until recent years, were not known to be harmful. Changing the customs of the people is an administrative task of no small magnitude.

Again taking up administration in its narrower sense, as applied to private affairs, the administration necessary for the reduction of the typhoid "Toll" should be governed by the policy that dividends must not be obtained by any risk of safety.

Just a word as to the author's thought that health departments should approve plans on the guarantee of the applicant that the proposed works will be of a certain standard efficiency, consider the files of the Patent Office, also the problem of correcting defective work once it is built, especially when tax payers' money must be obtained to correct the defects.

It is most fitting that the typhoid situation should be so thoroughly presented to the Water Works Association, and the writer congratulates the author on his timely paper.

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[14] Chief, Bureau of Health, Philadelphia, Pennsylvania.

Mr. Charles Saville[15] (by letter): Public health officials throughout the country owe a debt of gratitude to Mr. Johnson for collecting and tabulating such a vast amount of data regarding the prevalence of and losses from typhoid fever in the United States, and for presenting so forcefully the serious public health aspects of this problem.

Among the principal factors affecting the prevalence and spread of typhoid fever mentioned by Mr. Johnson are: (1) Pollution of public and private water supplies. (2) Typhoid carriers. (3) Infection from contaminated foods. (4) Infection through the house fly. (5) Failure of the average citizen to appreciate the unhealthful aspects of filthy surroundings, and his responsibility in this respect to the other members of the community in which he lives.

In the matter of water supplies it is now pretty generally recognized that every community should have an uncontaminated public water supply, which in many instances means providing a suitable purification plant. It still remains, however, for public health officials and sanitary engineers to convince municipal administrators that water purification plants require expert supervision in order to produce under all conditions a safe drinking water. The public health official likewise has the more or less difficult duty of convincing the members of his community that it is to their interest to use the public supply in preference to individual wells and cisterns on their own premises.

In the city of Dallas, a very considerable proportion of the typhoid fever cases during the past year have, without doubt, been due to the use of contaminated private water supplies on property which was supplied with city water.

Typhoid carriers are without doubt a very important factor in the spread of typhoid fever. Unfortunately, however, the average small community is not equipped to detect and to properly control such carriers.

The spread of typhoid fever no doubt takes place, to a certain extent, through contaminated foods, particularly raw milk, and much is being accomplished at the present time in the majority of our cities toward the proper control of the food and milk supply. One of the most serious factors, however, in the spread of this disease is the common house fly, which breeds in stable manure, and frequents unprotected privy vaults, finally visiting in large numbers our kitchens and dining rooms.

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[15] Director of Public Health, Dallas, Texas.

The excellent results mentioned by the author as having been secured in Jacksonville, Florida, through the simple means of making all privies fly tight have been duplicated in Richmond, Virginia, and a few other southern cities.

During the past year in Dallas one of the principal activities of the health department has consisted in abolishing unprotected privies and forcing the owners to provide sewer connections. During a period of ten months over seven hundred of these closets have been abolished, and it is felt that no phase of the work of the health department has been of more importance. This work, however, as well as that of making all necessary dry closets fly tight, continues to be extremely difficult on account of the lack of coöperation of the people, and the still prevalent idea that personal liberty comes before community responsibility.

Perhaps the principal activity of a modern well organized health department is its educational work. In this connection the writer cannot help wishing that much of the information in Mr. Johnson's excellent paper might be made available to the general public instead of only to the members of this association who already have an appreciation of the importance of the subject. The suggestion is offered that excellent results might be secured by having a brief summary prepared of all such papers, for distribution to the press throughout the country. With this in view the writer recommends that the association create, if provision is not already made for this, a committee on education, whose function would consist in furnishing to the general public such portions of its proceedings as would be instructive and helpful to the people at large.

Mr. Franz Schneider, Jr.[16] (by letter): A vigorous exposition, such as Mr. Johnson's, of the status of this country's typhoid problem, has particular value for the reason that this problem is symbolic of the country's interest in the welfare of its citizens. As Mr. Johnson has pointed out, typhoid is a thoroughly preventable disease. Our knowledge of the disease is remarkably complete; we have known the responsible bacillus for 36 years; we have a very satisfactory knowledge of the modes and sources of infection; and we have a prophylactic of proved value. In addition, we have had absolutely convincing demonstrations of the efficacy of the recognized methods of control; we have seen the disease eliminated from the army, and again and again have seen the reduction of the death rate following purification of a polluted water supply. Hardly a better example could be found of the astounding power gained by sanitation over disease. Yet Mr. Johnson is able to tell us that 300,000 persons suffer from typhoid in this country each year, and that of these 20,000 die. That is certainly something to think about.

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[16] Sanitarian, Department of Surveys and Exhibits, Russell Sage Foundation, New York City.

We know, however, that the situation is improving. Year by year more polluted water supplies are being purified, more health departments are being improved; and the typhoid rate is falling. At the same time, a disgracefully large number of polluted water supplies still exist, and the ordinary city health department, with its per capita appropriation for health purposes of 22 cents a year, is still a shocking example of municipal neglect. In a similar way, Congress apparently considers $3,000,000 an adequate appropriation for the federal public health service; but judges it wise to spend $20,000,000 each for five battle cruisers, and to go in for a navy building program calling for an expenditure of $160,000,000. Such a small proportion of the public funds, but 1 or 2 per cent, is spent for health that it is difficult to escape the depressing conclusion that the interest of our governments in the public health is relatively slight.

Mr. Johnson's emphasis on the importance of contact infection is certainly justified. The contagiousness of typhoid is one of the things about the disease that the public needs most to know. As water supplies are purified, wells and privies eliminated or regulated, and milk supplies pasteurized, contact infection becomes relatively more important. In a city with a good water supply and no special privy problem, it is probable that a third or a half of the cases may arise through direct contact. To prevent this kind of infection, use of the typhoid prophylactic and public health nurse are especially valuable. The city health department should visit reported cases promptly, and revisit them as necessary. Nurses are better than inspectors for this purpose; they are better fitted to instruct the family in proper care of the patient and prompt and efficient bedside disinfection of the discharges, and they cost less.

The best single way to work for the elimination of typhoid fever in this country is to work for better health departments, departments with adequate appropriations, full-time health officers, public health nurses, and laboratories. With such departments we shall have closer scrutiny of public water supplies, and better supervision of cases of the disease; we also shall have a strong force in each community working to educate the public and its representatives in the opportunities in, and the importance of, modern public health work.

MR. ROBERT B. MORSE[17] (by letter): The writer is more than ordinarily interested in Mr. Johnson's paper on "The Typhoid Toll" as, in 1912, it was his duty to organize the engineering division of the Maryland state department of health, and since then to direct its work and to watch the operation of one of the more recent and comprehensive state water supply and sewerage laws. Mr. Johnson emphasizes the importance of such laws for supervision over the character of water supplies in connection with the control of typhoid fever. However, he feels that a model water supply law would not require approval by a state health department of the physical features of water purification plants, giving as his reasons the possible inefficiency, arbitrariness, prejudiced attitude, or dilatory tactics of the public health officials.

The writer confidently believes that the omission from state water supply and sewerage laws of the clauses requiring the approval of all engineering details of plans and specifications would cut the very heart out of such laws and would defeat their object. He has no sympathy with those officials who, through provincialism or other cause, will not approve accepted methods of water purification and sewage treatment which are suitable for the case under consideration.

It is not sufficient to say that, because state officials may be inactive, inefficient or arbitrary, the law should be changed. Rather, the appropriation for carrying out the law should be increased, so that capable men could be obtained and so that a sufficiently large force could be employed to insure against delay in reviewing plans.

Concerning the question of delay, Mr. Johnson says that a time limit within which plans must be approved is necessary and that "As these laws now read the approval of such projects may, for one reason or another, be delayed indefinitely and to enforce action mandamus proceedings provide the only way out of the difficulty". In the view of the writer a time limit would be impracticable, since the projects which are submitted for approval are widely varied in character and magnitude and require varying amounts of study, investigation and detail work on the part of the health department engineers. Moreover, a set of plans may be submitted when there are numerous projects already before the health authorities, in which case it is impossible to pass upon them as quickly as otherwise.

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[17] Chief Engineer, Maryland State Department of Health, Baltimore, Maryland.

The Maryland law makes an attempt to deal with the matter of promptness in passing upon water supply or sewerage plans, for it states that "Whenever application shall be made to the state board of health for a permit under the provisions of this Section, it shall be the duty of the board to examine the application without delay, and, as soon as possible thereafter, to issue said permit, disapprove the application, or state the conditions under which said permit will be granted." In the rules and regulations which the Maryland state department of health has issued for the submission of plans, it is stated that a permit may not be expected by an applicant within two weeks after the date of the application, although in many cases permits for minor projects are actually issued within a shorter time. Sometimes those desiring permits for construction work are themselves at fault for any delay that may occur, for they have been known to have had plans finished for weeks, submitting them to the health authorities only when contracts are about to be let. Moreover, engineers many times pay little heed to the regulations for submitting plans and do not transmit the proper data upon which an intelligent review can be made. Whose fault is it then when changes have to be made and delay results?

Returning to the question of approval of detail plans, it would seem unfair for the health department to commit itself to the approval of any process unless it is allowed to pass upon the design to be used in connection therewith. Good results depend upon good engineering design, and if competent engineering judgment is not used in the preparation of plans, such results will not be attained. If satisfaction did not ensue, delay and unnecessary expense would be met with in having suitable changes made. And if the engineer of the health department had no supervision over the details of such alterations, it might be a long while before the structure would be in proper operation. If the highest class of engineering services were always available for the preparation of plans, there would be less need of the state engineer passing upon the physical features of the design submitted to him. Unfortunately, most small towns, and many of the larger ones, believe that the more competent engineers' services cost more than they can afford, and when they engage an engineer he is more than likely to be a local man with no particular aptitude for the work at hand. On the other hand, there have been some instances in the writer's experience where engineers of good standing have been inclined to give too little personal attention to small jobs, leaving them to subordinates with limited experience.

A state water supply and sewerage law, like a building law, is for the benefit of the public health and safety, and it seems to the writer that it is just as important for the engineer of the health department to pass upon all the phases of plans for water supply and sewerage improvements as it is for the building inspector to pass upon all features of building construction.

It is impossible to predict just what parts of an engineering design will have a bearing upon the public health, in any particular case, but the manner in which the health of a community may be affected is sometimes not apparent when the plans are submitted. For instance, some years ago the authorities of a small Maryland town gave a long-term franchise to a private party for the construction of a water system. At that time there was no law requiring the submission of plans to the state health department and the system was installed with small pipes and fire hydrants. Two years ago a bond issue for water and sewerage systems was voted by the citizens. If the existing water supply had been adequate as far as it went, the town would have purchased it as a nucleus for the new system, but the town could not afford to obtain and discard it and was prevented by law from putting in its own system without making an agreement with the owner. As a consequence, the community has been prevented for two years from obtaining the advantages of either an adequate water supply or a sewerage system.

The writer believes from his experience in Maryland that, in the interest of both public health and economy, the citizens of the state need the protection of the health department in reference to all details that enter into a water supply or sewerage improvement. In this state a law to this effect was passed early in 1914 and its operation has been attended with considerable success and with little real opposition. Everything possible is being done to encourage the installation of water supply and sewerage improvements. It is believed that work under this law has already had its effect upon the typhoid death rate in Maryland, particularly outside of Baltimore city, although it is still considerably higher than it ought to be and much higher than in many states where laws of the same character have been operative for a longer period. During the five years from 1909 to 1913 inclusive, the typhoid death rate in Maryland outside of Baltimore city was 39.8 per 100,000 population, in Baltimore 28.2, and in the state as a whole 34.8. In 1914 the corresponding figures were 25.8, 22.4 and 24.38, while in 1915 they were 26.4, 21.9 and 24.48.

Nearly all of the public surface water supplies in Maryland are now purified and it has been even necessary to disinfect some of those derived from underground sources. Out of 842,500 people served by public water systems, 745,000 or 88.4 per cent drink treated water and only 97,500 or 11.6 per cent use untreated water. Of the total population of the state, 62.1 per cent are served by public water systems, while of these 54.9 per cent use treated water and only 7.2 per cent untreated. In 1912, when the engineering division of the state health department was organized, there were only seven water purification plants in Maryland, while at present there are twenty-one, besides which six institutional supplies are treated.

There are, upon the average, twenty persons engaged upon the engineering work of the Maryland state department of health. Four district offices, besides the main office, are maintained, and the resident engineers in charge of these are enabled to come in close contact with the people in all sections and do much to encourage the movement for better water and sewerage services.

The comprehensive manner in which Mr. Johnson has treated the typhoid fever question in his paper is most instructive and the writer is pleased that he points out so clearly the value of centralized control in the reduction of the prevalence of this disease. He wishes that this phase of the subject might receive more frequent discussion.

Dr. Harvey W. Wiley[18] (by letter): The writer read a paper before the Massachusetts state board of agriculture during the holidays, in which he made a comparison of rural and urban health conditions, and particularly made a study of the typhoid rates, much along the same line as Mr. Johnson has followed in his paper. This paper has not as yet been published.

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[18] Director Bureau of Foods, Sanitation and Health, *Good Housekeeping Magazine*, Washington, D. C.

Mr. Johnson has put the matter into the form of graphic charts, which are much more readily comprehended by the reader than the ordinary statistical form; and is to be congratulated on having adopted this method of illustration. He is also to be congratulated on having put together this matter in such a compact form. In the manuscript of a book, which is now in the hands of the publishers, on beverages, the writer has treated the matter of the carrying of disease by water in some detail. Therefore, he is perhaps better informed than many others because of the recent careful study given to the questions which Mr. Johnson has so ably discussed in his paper. The best discussion of it is to commend it to everyone who is interested in the protection of our people from typhoid infection. It is not likely that all of us in the near future will be vaccinated against typhoid. We must depend, therefore, as a people, more upon sanitary control of sources of infection than on immunization by the introduction of dead typhoid bacilli into the blood. The writer believes that typhoid is on the wane; and is looking forward to a day when it will be as rare a disease, even rarer than smallpox. It is encouraging in the city of Washington, which for many years represented a continued typhoid infection, to find that the number of cases reported last week was only three, and that the total number of cases under treatment was only thirty-two. This of course is entirely too much, but when compared with Washington two or three years ago it seems like an almost complete victory.

Dr. E. C. Levy[19] (by letter): The paper of Mr. Johnson is a very complete summing up of the typhoid situation as understood today. There can be no question that the work which health departments have done in connection with typhoid fever alone has resulted in a financial saving greater than what these departments have expended for all purposes. Everything else which they have accomplished is therefore "velvet".

It is exceedingly gratifying to find that work which was done in Richmond in 1907 and 1908 is now everywhere accepted. At that time water and milk were held to be the great carriers of typhoid fever. Study of the Richmond situation brought out the fact that these factors were not the chief ones with us. The average annual typhoid fever death rate in Richmond for twenty-six years, 1880–1905, prior to reorganization of the Richmond health department had been 77.8 per 100,000. In only four years had the rate been below 50, and the lowest rate in any year during this period was 43.5.

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[19] Chief Health Officer, Richmond, Virginia.

After one year's study, the conclusion was reached that spread from local foci of infection was the main cause of our typhoid. There were at that time about 4500 privies in the city of Richmond, scarcely one of which was even in decent condition. The board of health adopted rigid rules and regulations governing the construction and maintenance of privies and put special inspectors at work getting into proper condition all privies on premises which could not be reached by water and sewerage services. The city spent $1,000,000 for the extension of its sewerage and water systems. As a result of this, the typhoid fever death rate immediately dropped to 24.1, with the water supply entirely unchanged. This was in 1909. Since then the rate has steadily fallen, year by year, until in 1915 the rate of 12.3 was reached, which is phenomenally low for a Southern city. This rate meant 19 deaths. Of these 19, 6 were contracted outside of the city. Of the remaining 13, the diagnosis was exceedingly doubtful in 4 cases, leaving only 9 deaths from typhoid fever contracted in Richmond in which the diagnosis was certain. This was equivalent to a rate of 5.8 per 100,000.

It cannot be too strongly urged that typhoid fever in the North is usually a question of the water and milk supply, while in the South it is very largely a question of spread from local foci of infection. The Southern typhoid is mostly summer typhoid, and summer typhoid even in the North is seldom due to water. A pure water supply is of course as important in the South as it is in the North, but its relative importance in comparison with other means by which typhoid is spread is greater in the North than it is in the South.

Mr. Johnson's effort to show the actual financial profit to be gained by controlling typhoid should be brought to the attention of all municipal and state authorities having control of appropriations. The writer cannot agree that the death rate of any community can be indefinitely lowered by spending more money, but there can be absolutely no question as to the ability of the health authorities to banish typhoid completely if only they are given sufficient appropriations wherewith to bring about this result. Certainly most health officers would only too gladly undertake such a contract.

A movement of this kind, however, would have to be nationwide. If even forty-seven of our states were to undertake this work, it would result in failure if the forty-eighth state did nothing and served as a source of cases.

In some ways it is unfortunate that the only disease against which special societies, national, state and municipal, have been organized should be the one disease most difficult of control, namely, tuberculosis. There can be no question but that one-tenth the organized effort, the general interest and the actual expenditure of money if directed against typhoid fever would by now have practically eliminated this disease, while in the case of tuberculosis we often doubt whether we have even yet gotten to the point of knowing what to do.

DR. CHARLES V. CHAPIN[20] (by letter): Mr. Johnson's paper is a timely and valuable contribution to the subject. It is interesting that some of the most valuable books and papers relating to typhoid fever have come from non-medical men, and it is pleasant to note how the scientific training of the engineer prevents him from taking a narrow view. All of us, whether engineers or medical men, alike think of infected water as the chief factor in the causation of typhoid fever, and so it has been in the past. Fortunately there has been most remarkable progress, and in a very considerable number of our larger cities, the influence of the public water supply, formerly of supreme importance, has become nil, or very slight. This paper should be the means of inciting to still further progress, and it is hoped that the time will come in the not very distant future when public waters in the United States, as in some parts of Europe, will have little or nothing to do with the causation of typhoid fever. It is difficult for some English health officials to believe in the tremendous importance of water borne typhoid fever in the United States. A municipal health officer living in a city where the water supply is properly safeguarded naturally turns his attention to sources which there are more important. It is gratifying that the engineer also fully appreciates the importance of the removal of privies, the protection of food, particularly of milk, the skilled investigation and supervision of all cases and last, in well sewered Northern cities, the control of the house fly.

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[20] Superintendent of Health, Providence, Rhode Island.

Dr. Rupert Blue[21] (by letter): The extent and importance of the problem of typhoid fever have been clearly and convincingly set forth in Mr. Johnson's paper. As further remarks along these lines can be scarcely more than repetition the writer will take this opportunity for describing very briefly the character of the studies which the public health service has been making in connection with rural sanitation.

In these investigations it has been the object of the department to ascertain with a reasonable degree of accuracy the sanitary conditions which prevail in the rural districts of the United States, and to determine what improvements would result from a detailed survey of these conditions under the direct observation of the people immediately exposed to and responsible for them. In the course of these studies the rural dwellers are urged to take the well known precautions necessary for their protection against disease, and local health organization and administration are encouraged in order that local full-time health officers may be employed by communities and depended upon to improve sanitary conditions.

In those districts selected for special study the usual procedure has been to inform the citizens of the purposes of the survey by means of circular letters signed by the Surgeon General of the Public Health Service and endorsed by the state health officer.

A canvass and survey of all the homes outside incorporated towns are then made, especial attention being given to the disposal of excreta, and to water supplies, refuse disposal and foods.

Sanitary surveys of all incorporated towns are made, and similar attention is directed to the disposal of excreta, stable manure, garbage, and to water and food supplies.

Literature on sanitary subjects is distributed to practically all homes, and public meetings and lectures on sanitation are held in as many neighborhoods and as frequently as seems advisable. The lectures are usually illustrated with stereopticon slides.

Following the survey of each town a report of the findings together with specific recommendations is made to the local authorities. Such reports also include inspections of schools, churches, railroad stations, post offices and stores.

An important part of the work consists of resurveys of towns and revisits to rural homes in order to note the sanitary improvements which have been made since the first visit and to indicate further improvements needed.

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[21] Surgeon General United States Public Health Service.

During the past two seasons, a canvass and survey of 47,971 homes has been made and 8842 of these have been revisited.

The vast majority of the people interviewed were found either to be entirely uninformed or to have very erroneous ideas about the source and the modes of spread of typhoid fever and of other excreta-borne infections, and about the principles of preventing dangerous pollution of the soil and of water supplies.

In all of the districts surveyed, however, marked improvement had been made in the methods of disposal of human excreta, in water supplies, and in screening to prevent flies from having access to foods.

In several of the counties over 25 per cent of the strictly country homes made in the course of the surveys radical improvement in the construction of privies.

Much remains to be done, however, and under existing dietary and sanitary conditions there will be in our rural districts in 1916 thousands of deaths and hundreds of thousands of cases of illness which are preventable by measures now as definitely known as are those for the prevention of the spread of yellow fever or smallpox.

MR. CORNELIUS C. VERMEULE[22] (by letter): The author has collected and digested a large amount of valuable data concerning the connection between typhoid fever and domestic water supply, purified and unpurified. The case for filtration of public water supplies is admirably presented, and in the opinion of the writer fully sustained. No achievement of modern sanitary engineering is more marked or better proven than this. The diagnosis of typhoid is not likely to be erroneous as the bacillus is identified with much certainty. There is no question that the filtration of potable water has been the principal agency in the reduction of this disease, although certainly other sanitary measures have been of assistance. The progress made through filtration is brought home to many of us when we reconsider views of a quarter century ago, which some of us were unfortunate enough to put on record. The pain of acknowledging that there was a time when we did not know everything, however, is always greatly mitigated by the proud realization that we have continued to learn.

[22] Civil Engineer, New York City.

By way of further palliation, the writer will venture to quote some words of his own which in his opinion have been amply justified by later experience. They referred to uncertainties in the interpretation of both chemical and bacteriological analyses as matters stood twenty-five years ago, but are not entirely inapplicable to present conditions:

> Unfortunately these uncertainties are sometimes made the basis for belittling or ignoring the warnings of such analyses, and frequently at the expense of large communities. The very reverse course would seem to be the wisest and most sensible one. Our ignorance in these matters should only breed the greater caution. In the absence of better data, we may perhaps go so far as to say that no source of supply which is repulsive to the natural instincts of intelligent persons should be tolerated. The senses of sight, smell and taste should always be exercised for our protection in the absence of other means, and only the most thorough and conclusive proof that such repulsive waters are not deleterious should be sufficient warrant for continuing their use.

Not the least of the advantages of filtration has been the improved appearance of the water, which has the same beneficial effect on the user as savory and attractively served food, while it is an invitation and incentive to greater cleanliness and a better appreciation of all sanitary measures.

Mr. Johnson quotes an average value of $3600 for each human life lost by typhoid fever. An investigation of this subject begun by the writer many years ago, but laid aside in the press of every day practice, showed that in an industrial city not far from New York, the average earnings of about 40 per cent of the population engaged in gainful occupation, amounted to $573 yearly, while the total earnings of the entire population amounted to $234 yearly per capita. The latter earnings continued twenty-five years, have a present worth, at 5 per cent of $3297 while the earnings of the workers would be worth $8073. In this particular case the average value of a human life in that city would not be represented by the smaller amount, because many not classed as gainfully occupied, such as the housewives and mothers of families, are worth the larger sum. The author's table 11 must also be taken into account, it shows that 75 per cent of the deaths from typhoid are of persons between the ages of 10 and 49, thus including a large proportion of the wage earners. His adopted value is certainly not too large.

He points out what has always seemed to the writer very important, namely, the additional deaths caused by a depleted vitality among those who recover from typhoid. This means that the actual effect on the total death rate is much greater than that due to the typhoid deaths alone. An attempt to suggest this was included in the unfinished paper already referred to. The reduction in typhoid in the city of Newark, New Jersey, due to the introduction of a pure water supply in 1892, was accompanied by a still greater reduction in the total death rate, which from 1886 to 1892 averaged 25.87; and from 1893 to 1899, 20.76; whereas during the same periods, in all other cities in New Jersey the figures were 22.05 and 19.62 respectively. That is, there was a reduction of 5.11 per 1000 in Newark, as against 2.43 in all other cities of the state. Assuming that the additional saving of 2.68 per 1000 in Newark was due to the introduction of pure water, it represented 485 lives saved yearly; whereas the reduction in typhoid deaths alone was only 60 yearly. On the same basis of comparison Jersey City showed a reduction in total death rate of 3.22 per 1000, greater than the whole state, representing 664 lives saved, of which only 109 were accounted for by the typhoid rate alone, and in Paterson a reduction of 1.76 per 1000 greater, representing 184 lives of which 21 represented the saving in deaths from typhoid. Even if not proven, surely these instances suggest that the total saving of life due to the introduction of pure water may be six or seven times that which is represented by the typhoid death rate alone. It is noticeable that those cities which have a low typhoid death rate almost invariably have a total death rate lower by a much greater amount than the difference in typhoid deaths. This may be due partly to the lowered vitality noted by Mr. Johnson and partly to the effect of diarrheal and other diseases chargeable to polluted water, but not so easily traced as typhoid.

Up to April, 1892, the city of Newark took its supply from the Passaic River at Belleville. It then introduced a pure supply from the Pequannock River, collected from a drainage basin, which had a scattered population of about 40 to the square mile, 80 per cent of the area being woodland. It was practically free from sewage pollution and has been maintained in good condition by large purchases of land and the removal of dwellings. For five years previous to the introduction of this supply, the deaths from typhoid had averaged 108 yearly. The average for five years after was 48 yearly. It is interesting to note that from November to June, the average number of deaths before was 76 and after 22, a reduction of 71 per cent, while from July to October, the average was 35 before and 22 after, a reduction of only 37 per cent. During the vacation months much of the typhoid was caused by drinking water from other sources than the public water supply, while no doubt, flies, oysters and uncooked vegetables also had their effect. Unquestionably, the public water supply was chargeable with a less percentage of the total number of deaths from typhoid from July to October than during the remainder of the year.

In spite of the prevalence of typhoid in both Jersey City and Newark, while they were using sewage laden water from Belleville, the writer noticed evidences of a very considerable degree of immunity. Had it not been for this, undoubtedly typhoid would have been epidemic in these communities to a much greater degree than actually obtained. There were some evidences that this immunity was lost after the introduction of pure water. In March and April, 1899, after the new supply had been in use seven years, owing to a shortage in the Pequannock supply, some water was turned into the mains from the old supply at Belleville. Immediately typhoid developed, and the number of deaths during the two months ran up to 42, whereas before the new supply had been introduced, when Belleville water was used exclusively, the average for the two months had been 13 and the maximum 25.

Jersey City used a supply from Belleville until 1896, when it introduced water from the Pequannock; not a full supply, however, until the beginning of 1897. During the five years preceding, the average typhoid rate per 100,000 population was 74, and during the five years following, it was 21. These figures may be compared with 69 before, and 23 after for Newark.

It would seem that there is still more to learn as to the full effect of a change to pure water, because the reduction in typhoid appears to continue for some years after. Even if this is aided by the introduction of other sanitary measures, it will be conceded that such measures are more likely to be introduced, and their importance is more likely to be realized, after the one principal cause, namely, a polluted water supply, has been removed. There is not, as yet sufficient experience as to this after effect, but the following figures are suggestive:

	BEFORE	AFTER	1910–13	DATE OF CHANGE
Newark	69	23	9	1892
Lawrence	110	23	13	1893
Jersey City	74	21	10	1896
Albany	109	28	19	1899
Paterson	29	9	8	1904
Washington	55	31	24	1907
Pittsburgh	132	19	12	1908

While all of the foregoing illustrations are not cases of filtration, they are, nevertheless, pertinent. It is noticeable that for the first five years after the introduction of pure water, the above cities show an average rate of 22 typhoid deaths for 100,000 population, whereas the average for those in which the change occurred not later than 1904, had fallen to 12 in the period 1910-1913.

As a reminder of things still to be learned, the writer had in mind three communities of from 12,000 to 40,000 population, all of well to do and intelligent people, in none of which is there any reason to suspect the water, and yet during the period from 1908 to 1912, the typhoid death rate per 100,000 was in A, 32, in B 23, and in C 7, while the total death rate per 1000 was in A 22.4, in B 14.1, and in C 9.2. In two other communities of similar population, mainly industrial, with many workers of rather low order of intelligence and a safe water supply, typhoid rates were in D 17, and in E, 19; and the total death rate D 17.8, and E 14.0. A is the wealthiest of all, intelligent and the least crowded, while E is the worst housed, the poorest, and least intelligent. Perhaps its people have a higher power of resistance to disease.

In most of the cities of the United States, improvements can only be achieved through filtration, but it is interesting to note that in the case of the Pequannock supply to Newark, it has been attained by removing the sources of pollution on the catchment, while Jersey City, with some pollution and ample sedimentation, appears to have accomplished fairly good results thus far by the use of hypochlorite or chlorine, without having inspired confidence, however, that actual cleansing of the water by filtration will not ultimately be necessary. Boston, also, has accomplished a progressive reduction from 48 to 8 by other measures than filtration, while New York has reduced its typhoid rate from 27 to 10 by similar measures. The results achieved in these four cities, without filtration, when compared with those had by filtering such badly polluted sources as at Albany and Philadelphia, indicate that we should first acquire the best source of supply within reach, then filter when it becomes necessary. Clearly filtration will be all sufficient when we abandon the discharge of raw sewage into our streams and lakes.

MR. LOUIS L. TRIBUS[23] (by letter): To the man who gives time to gather and classify statistics on any subject and cleverly weaves them together into a comprehensive and understandable whole, are due the thanks of his associates. The author has presented a paper which should convince the skeptical municipal official and impress the taxpaying public. Dollars and cents are the most potent factors in public welfare in the last analysis, but "sentiment" controls until the hard facts of a money pinch make themselves felt. The reality of the value of human life and effort to the community, from a monetary standard, is not often honestly considered. The factory measures human effort on a standardized machine basis, though occasionally some enlightened corporation looks further and measures operatives' work on a humanitarian basis as well as in light of current output.

Typhoid is the disease that comes most to the attention of the average engineer because of his sanitary work, but tuberculosis may also well require thought in his city planning and pavement questions. Disease creates expense; dust contributes to disease; cleanliness lessens dust; good pavements call for cleanliness; pavements cost money; therefore expense due to disease vs. expense due to pavements is quite analagous to net value of filter plants for safe water; sewage disposal works to save streams; garbage treatment systems to prevent flies and other nuisances. Proper housing, playgrounds, cultivation of the esthetic, make for happiness, happiness for good work, good work for financial and economic betterment, dollars saved and dollars made.

The problem is always an interesting one as to how far one community, whose natural outlet for drainage is a fresh water stream, should be obliged to purify its sewage; and how far the community further down stream should be obliged to purify its drinking water. They both have natural rights to the use of the stream. As a moral question it probably is incumbent upon the upper party to refrain from seriously injuring the quality of the water which is to be used by those further down stream. There is no question that it is incumbent on both to take steps to prevent all prevalence of typhoid fever, or other avoidable diseases.

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[23] Consulting Engineer, New York City.

The author has very wisely called attention to the fact that practically every sewage disposal plant is likely to fail in its work on some occasion, with the result that untreated, or half treated sewage finds its way into a stream. Under such conditions it is imperative that water supplies, if taken from the same stream, should be protected by appropriate forms of water treatment. These conditions are in general more important where sewage passes into fresh water, but in particular instances they have applicability where it is debouched into tidal waters. In such instances, aside from the question of nuisance to sight and smell, the relationship of fish and shell fish industries must be considered. Where such an enormous total of sewage as flows into the harbor of New York and its estuaries is under consideration, the expense of sewage purification work, as against the total value of the fish and shell fish industry is so overwhelmingly greater, as to make the industry practically negligible. New York and vicinity could very readily forego all fish food if such could only be derived from its own waters, rather than meet the expense necessary to purify its sewage so as to safeguard its fish, oysters and clams. Not so, however, with Chesapeake Bay and its estuaries, for the shell fish industry is there of practically international importance, consequently very large expense for sewage treatment is perfectly justifiable.

Though one may even estimate a financial value for human life and human service, which as a business proposition can be compared with the cost of decreasing a disease, there is no moral right to weigh one against the other; it is not amelioration, but absolute prevention that propriety demands.

Such figures as the author has presented are appalling and should carry great weight when studied and understood by those in responsible charge in our cities. Even so vast in importance as is the subject, it will only be given due weight when public sentiment is aroused; sentiment causes the expenditure of probably more money than any other cause, and often it is spent without much logic or real financial advantage.

The pictures which have been spread broad cast in the last few years, of flies proceeding from unpleasant materials to the bottle containing the baby's milk, thus arousing sentiment, have done more towards abating the fly nuisance than all the statistics which demonstrated to a nicety that the fly is dangerous to human life.

The writer heartily advocates the compilation of statistics and the working out of figures to demonstrate the financial value of municipal improvements and heartily approves of their promulgation and their continual presentation for public enlightenment, but that intangible something, community sentiment, must be aroused before tangible results can be secured. The more of such papers the better.

PROF. IRVING FISHER[24] (by letter): Mr. Johnson's paper, "The Typhoid Toll", the writer considers a splendid presentation of the typhoid problem, and hopes it will receive the widest publicity possible. It is doubtless the most complete statement ever made of the typhoid situation, and the most convincing presentation of the criminal negligence through which typhoid is still allowed to exist. If these facts could be presented to the general public in the telling form in which Mr. Johnson has given them, the effect would be a wonderful improvement.

DR. WILLIAM A. EVANS[25] (by letter): We are grateful to Mr. Johnson for gathering this mass of information relative to the amount of typhoid fever, its cost in money and lives, and the success of the efforts which are being made to control it.

A few years ago there were several cities which were typhoid pest holes. They fed typhoid to other cities as well as to the rural districts. Practically all of these old-time city pest holes have purified their water supplies and are now no longer typhoid foci.

As the essayist says, it is now the rural districts which feed typhoid to the cities. The writer does not agree with the author that the rural citizen is essentially different from the city citizen. When the city man is depended on individually to control typhoid by boiling the water, preventing flies and pasteurizing the milk he falls down, just as does the country man. The reason for the greater security of the city man is because the government assumes charge of the water and in some degree, though lesser, controls fly breeding, supervises the milk, hospitalizes the cases and sends community nurses into the homes. In a few years the government, employing different methods, however, will be rendering the same service to the countryman, whereupon the country will cease to feed typhoid to the cities.

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[24] Department of Political Economy, Yale University.

[25] Health Department, *The Chicago Tribune*, Chicago, Illinois.

Perhaps the writer does not agree with the conclusions expressed on page 272. The statements of fact are correct. The disagreement is as to the remedy. When the proposals for a water purification plant are being considered the amount of money involved and the inconveniences of the installation period are such that probably the communities will want the advice of experts in addition to guarantees. The better proposal is that in every health department there should be some one in authority with technical training and experience in sanitary engineering and particularly in water engineering.

The writer has been particularly impressed with the chart on page 281 showing the very much higher typhoid summer peak in the country as compared with the city. The explanations of this high peak given by Mr. Johnson state the facts.

As to the table 11 on page 284 we are liable to get an exaggerated idea of the immunity of people past 40 from this table. It is hoped Mr. Johnson will prepare another table showing the age distribution of the people in the registration area. Such a table would show, for instance, that one reason why the typhoid deaths among people 50 to 59 years of age is only 6.6 per cent of the total is because the population with ages between 50 and 59 is not large. Of course, the heavy incidence of typhoid is in persons in the groups with ages from 10 to 19 and 20 to 29 years, but the difference between the incidence of those groups and the incidence of 50 to 59 years, for instance, is not so great as the figures indicate.

Many ordinances and rules now make a distinction between the restrictions placed upon a house where a trained nurse is caring for the typhoid patient, and one where members of the family act as nurse. Reading pages 290–291 the thought comes into the writer's mind that we will not be able to prevent contact infections, or "finger" infection, until we either require that all typhoid be hospitalized, or else that that which is not hospitalized shall be cared for in the home by trained nurses, community nurses or private nurses.

Dr. Levy of Richmond has had just as striking proof of the relation of flies and privies as that cited from Dr. Terry of Jacksonville on page 299.

Mr. Johnson is right in his opinion that water purification will reduce the typhoid rate more than Dr. Freeman states. Probably a materially greater reduction can be expected than Mr. Johnson claims. When the water borne typhoid is eliminated, in addition to the reduction in direct water-caused cases, there is a reduction in the indirect or secondary cases. These should be added to the expected reductions in typhoid as a result of water purification.

As to table 20 in the Appendix, the JOURNAL OF THE AMERICAN MEDICAL ASSOCIATION for April 22, 1916, furnishes the typhoid data for American cities for 1914 and 1915.

The article by Mr. Johnson makes no extravagant claims. In fact if it errs at all it errs on the side of conservatism.

PROF. C.-E. A. WINSLOW[26] (by letter): Nearly fourteen years ago at the New Orleans meeting of the American Public Health Association, December, 1902, Prof. W. T. Sedgwick and the writer presented a paper "On the Relative Importance of Public Water Supplies and Other Factors in the Causation of Typhoid Fever", with the following conclusion.

> We have undertaken to show:
>
> First. That in the State of Massachusetts and in some of the larger cities of the United States the public water supplies are now unimportant as vehicles of typhoid fever.
>
> Second. That in cities having pure water supplies the annual curve of typhoid fever mortality closely follows that of annual temperature.
>
> Third. That in urban communities supplied with pure water there still remains a typhoid fever tax of from 15 to 25 deaths per 100,000 population.
>
> Fourth. That this tax is due not to any peculiar condition of soil, locality or climate, endemic factors, but to incomplete disinfection of typhoid excreta with subsequent infection of various articles of food and drink. These factors, when acting upon a few or many persons at one time, may cause obvious epidemics, sometimes large, though generally small; but more often the infection in moving from one point to another follows different and obscure routes for different victims, and hence may be described as *prosodemic*.
>
> Fifth. That the only remedies for such prosodemic typhoid are absolutely thorough and universal cleanliness and disinfection of excreta.

Reference is made to this paper because the authors were probably the first observers in this country to call attention to the importance of non-water borne prosodemic typhoid and to the significance of the seasonal curve of the disease in determining whether in a given community typhoid fever is or is not primarily a water borne disease; and also because the conclusion that a death rate of 15 to 25 per 100,000 was a normal death rate is interesting in the light of recent progress.

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[26] Prof. of Public Health, Yale University.

The following comparison of the typhoid death rates in large American cities in 1903 and 1913 from Table 20 in Mr. Johnson's paper brings out in a striking way the progress that has been made in the last ten years.

Typhoid death rates in large American cities in 1903 and 1913. Number of cities in each class. Typhoid death rate per 100,000.*

	10 AND UNDER	11-20	21-30	31-40	41 AND OVER
1903	2	19	13	12	28
1913	21	33	15	3	5

* The numbers in the two lines do not check, because data were not available for four of the cities, Birmingham, Des Moines, Los Angeles, and Wilkesbarre in 1903; while in 1913 Allegheny had been made a part of Pittsburgh.

Wonderful progress has been made during the past decade but we are still a long way from the standard of the best European cities, where typhoid death rates under 5 are by no means rare. The preparation of Mr. Johnson's admirable and exhaustive study is therefore an event of unusual importance, and should establish a landmark in the development of American sanitation.

The securing of pure water supplies placed within the reach of every community by the development of the process of chlorine disinfection, and pasteurization of milk supplies, which should be made a universal practice, have almost done away in progressive communities with widespread epidemics of typhoid fever. The prosodemic spread of the disease, however, by diverse and mysterious individual pathways, remains a serious problem. "Food, fingers, and flies," to resort to the expressive phrase which has been used so much in popular health literature, are the principal vehicles of this disease, and in the individual case they are exceedingly difficult to control. The only point that the writer finds to criticise in Mr. Johnson's suggestive comment on the fine array of statistics which he has collected is his statement that the susceptibility to typhoid is just as great in a person who bathes every day as in those of less cleanly habits. If bathing is correlated, as it undoubtedly is, with general social conditions, the truth of this is doubtful. In a recent study of typhoid statistics in New Haven, for example, the writer has been greatly impressed with the fact that the high rates are invariably associated with congestion of population and with poverty, following very closely the distribution of the high death rates from tuberculosis and infant mortality.

Municipal cleanness, particularly those phases of it which relate to the disposal of human excrement and the breeding of flies, and personal cleanness, particularly in regard to the preparation of food, seem to be the remedies, and these involve a slow and persistent process of public education in which the schools must play an increasingly important part.

Meanwhile mention should certainly be made of one important weapon, namely, that of anti-typhoid vaccination. The brilliant results obtained by the use of this procedure in the United States Army, and the less complete but significantly successful results obtained in Europe during the great war, make it clear that the use of typhoid vaccine ought to be stimulated by every possible means. In particular no one who is especially exposed, as are nurses and doctors and persons who travel a good deal, such as engineers for example, should neglect this simple and generally effective measure of protection.

MR. J. W. ELLMS[27] (by letter): The forceful manner in which the subject matter of this paper is presented should have the effect of breaking down the indifference of the public to matters of health, and of educating officials responsible for initiating sanitary reforms. That "money saved is money earned" is an axiom that apparently finds small favor with the American public; and only by the slow process of education can the truth of this saying be driven home in its application to abolishing insanitary conditions.

The remarkable reduction in typhoid fever almost always effected when a polluted public water supply is purified has served to emphasize this source of infection to the exclusion of other sources. Even after the purification of a water supply has successfully demonstrated a marked reduction in the prevalence of water borne diseases, the residual cases are sometimes looked upon with suspicion as possibly due to the imperfections of the methods of purification adopted. In some cases this may be true. Only by the most careful supervision can the quality of the purified water supply be maintained, and the reason for suspicion allayed. Even among sanitarians there appears to be a willingness to allow the purified water supply to be held responsible for all water borne diseases not traceable to other sources. This is largely due to the bad reputation which the water supply acquired prior to its purification, and is perhaps quite natural.

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[27] Superintendent, Filtration Plant, Cincinnati, Ohio.

The point which the writer desires to emphasize, however, is that in any properly conducted sanitary survey the sources of infection should be as carefully traced as possible, and to each source should be charged only the cases and deaths that the evidence obtained will substantiate. The complexity of such a survey is fully appreciated, but after all does not its value depend upon the reliability and positiveness with which the true sources of infection are ferreted out?

This matter has a practical bearing, in that intestinal diseases traced to dirty milk, unclean vegetables, contaminated shell fish, unscreened out houses, etc., may be made the subject of sanitary regulations, and these regulations enforced at comparatively small cost to the community. On the other hand, the elimination of pollution in a public water supply is a community matter that requires the expenditure of considerable sums of money. Epidemiological studies, therefore, should indicate as definitely as possible to what extent the public water supply is responsible for water borne diseases.

These sanitary surveys should be systematically carried on in every community, and the information obtained should be published and made the basis for pushing forward sanitary reforms intelligently. In this way the public will become educated to see its own needs, and will be far readier to furnish the funds to remedy unhealthful conditions.

MR. W. H. DITTOE[28] (by letter): As a factor in reducing the prevalence of typhoid fever, and deaths resulting from this disease, the development of water purification in Ohio must be given an important place. The first purification plant for a municipal water supply in the state was installed in 1895. Since that time the development has been active, and on January 1, 1916, there were thirty-five water purification plants serving forty-eight communities, with a total population of approximately 1,340,000. During the present year seven new plants will be completed and placed in operation, and with these, seventy-one municipalities with a total population of 2,200,000 will be served with filtered water. At the end of the present year the following conditions, as regards public water supplies in Ohio, will obtain.

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[28] Chief Engineer State Board of Health, Columbus, Ohio.

CLASS OF SUPPLY	POPULATION OF MUNICIPALITIES SERVED	TOTAL POPULATION SERVED BY PUBLIC WATER SUPPLIES	TOTAL POPULATION OF STATE
		per cent	*per cent*
Surface water—filtered	2,205,000	64.6	41.6
Surface water—disinfected only	89,000	2.6	1.7
Surface water—untreated	97,000	2.8	1.8
Mixed supplies (untreated surface water and ground water)	16,000	0.5	0.3
Ground water	1,008,000	29.5	19.0
Total	3,415,000	100.0	64.4

The population not accessible to public water supplies is 1,881,000, representing 35.6 per cent of the total population of the state. This population is made up of 252,000 residing in 458 small villages, and 1,629,000 which is truly rural. Of the 458 communities not provided with public water supplies only three have populations exceeding 2500, and forty have populations of 1000 or more. In these communities marked reduction of typhoid fever may be brought about by the installation of public water supplies of good quality.

In view of the fact that before the end of the present year 87 per cent of the population of the state, residing in incorporated communities, will have access to public water supplies which are filtered or obtained from ground sources, it is apparent that much has been accomplished to safeguard the state as a whole from the danger of typhoid fever due to polluted public water supplies.

Dr. Frank G. Boudreau[29] (by letter): There is great need for the public presentation of the problem of typhoid fever prevention in a clear and concise way. The study Mr. Johnson has made for the country as a whole, state officials should make for the individual states and city officials for municipalities. In other words, close study of the prevention of this filthborne disease is needed. Unfortunately, as Mr. Johnson has pointed out, facts upon which to base such a study are lacking. In Ohio a record of typhoid fever and other deaths was begun about 1870, but accuracy was not approached until 1909, when the state was admitted into the United States registration area for deaths. In 1882, incomplete records show that more than 2000 deaths occurred. In 1915 only 718 deaths occurred. Had the rate which obtained in 1882 held until the present time, more than 3500 deaths would have occurred in Ohio in 1915. A major part of the responsibility for the reduction of typhoid fever must be credited as Mr. Johnson has so clearly shown, to the purification of surface water supplies. In Ohio in the early nineties typhoid fever death rate curves for the cities rose higher and higher as sewage pollution of the streams utilized for water supplies increased. This tendency for increasing typhoid fever death rates was in some cases arrested temporarily by the removal of intakes from nearby pollution. The best example of this occurred in Cleveland. In 1903 a widespread and clearly water borne typhoid fever epidemic occurred during January, February and March. In 1904, the intake crib was removed to a point four miles directly north of the Cuyahoga River, a sewage-laden stream. Following this the typhoid fever death rate has never risen above 20 per 100,000 living persons. However, careful studies showed that water borne typhoid fever was still occurring in Cleveland, and in 1911 disinfection of the water supply with calcium hypochlorite was resorted to. In 1916 rapid sand filtration with disinfection as an auxiliary measure will replace the present system.

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[29] Director Division of Communicable Diseases of the Ohio State Board of Health.

In eleven cities and three villages of Ohio with an aggregate population of nearly a million, filtration of public water supplies reduced the number of typhoid fever deaths over 62 per cent. The reduction was roughly from an average rate of 60 for the five years before filtration to an average of 20 per 100,000 for the five years following the installation of filters. Dozens of Ohio cities and villages were not included in this compilation either because reliable data as to typhoid fever deaths were not available, or because filters were installed too recently to allow a five years study of their results. Among the eleven cities and villages included in the compilation were some which experience little benefit from filtration as far as typhoid fever is concerned. Toledo is the best example. In that city a water having undesirable physical characteristics was used prior to filtration. The citizens did not become accustomed to the use of this water, but used well water for drinking purposes, as ground water is abundant and easily secured. A recent census of seventy representative city blocks formed the basis of an estimate that there are 10,000 private wells in Toledo. In addition, the gross prevalence of typhoid fever for a number of years in one ward of that city was shown to be due to the milk supply. A typhoid fever carrier was found at one of the dairies.

Filtration of the public water supply was most effective in Cincinnati, so far as typhoid fever is concerned. The typhoid fever death rate fell below twenty immediately, and has fallen below ten during the last four years. Further, the monthly distribution of typhoid fever deaths obtaining prior to filtration was completely reversed following the installation of filters, and the seasonal distribution of typhoid fever in Cincinnati is now similar to that found in cities with pure water supplies.

In Youngstown, filtration of the public water supply was followed by an immediate reduction in the typhoid fever death rate, but the number of such deaths continued high. Hansen studied the situation in 1906 and found that a large majority of the cases were in houses connected neither with the public water supply nor with sewers.

The reduction of residual typhoid fever has not been so successful in Ohio as the reduction of the water borne variety. Cincinnati has been perhaps most successful. In Cleveland, water borne typhoid fever perhaps still exists, but that due to other sources has been appreciably reduced. Probably the lack of success in reducing residual typhoid fever has been due in part to lack of proper supervision of milk supplies. Of the twenty largest cities in the state, Steubenville and Ashtabula are the only ones not supervising the milk supplies. Youngstown was the first city to practice supervision, June 1902. Portsmouth and Lima did not begin inspection until 1913. Health officials of nine cities state that supervision of the milk supply is now efficient. Fourteen cities report that all dairies are regularly inspected. Bacterial counts are made by health departments of fourteen cities, and thirteen cities require bacterial standards varying from 100,000 to 1,000,000 bacteria per cubic centimeter. Eight cities report that dairy supervision has had a good effect in preventing typhoid fever. Six cities publish the results of dairy inspection and milk analysis. In thirteen cities typhoid fever cases are checked against the dairyman supplying the milk. To summarize briefly, in not more than five of the twenty largest cities of Ohio does supervision of the milk supplies approach the ideal. In half of the cities some of the simplest precautions that are effective in preventing milk borne typhoid fever are neglected. Only three cities require pasteurization.

Since 1886, when the Ohio State Board of Health was established, 102 typhoid fever outbreaks have been investigated by representatives of the board. Fairly complete reports of fifty-seven outbreaks are on record. Of these, twenty-four were water borne, nineteen milk borne, eleven were due to contact, and three to food. Sixteen of the twenty-four water borne outbreaks were traceable to public water supplies. Three of these were due to faulty operation of filters, three to the introduction of raw, polluted water into the public supply by means of industrial connections, and the use of emergency intakes was responsible for seven. Of the nineteen milk borne outbreaks, typhoid fever cases or carriers were found at the dairies in eleven instances. Oysters were responsible for one outbreak of paratyphoid fever.

The prevention of typhoid fever has been thoroughly discussed by Mr. Johnson. Emphasis should be laid upon his statements in regard to the inexcusable loss from water borne typhoid fever, and the necessity for state supervision of filter plants when once installed. Supervision of milk supplies is still in its infancy and must be extended and intensified. The prevention of sewage pollution of streams should not be delayed until the danger point has been passed. Public health education and close study of all cases are requisites too often neglected in the prevention of typhoid fever. Using the most conservative figures, typhoid fever causes an average annual loss of $4,350,000 in Ohio. According to Mr. Johnson's estimates, the annual capital loss from typhoid fever in Ohio averages $7,900,000. The judicious expenditure of a small proportion of this sum every year in Ohio would pay dividends entirely out of proportion to the sum expended.

MR. C. A. EMERSON, JR.[30] (by letter): The author has collected and correlated a mass of facts and figures that should bring home to all the truth that funds invested in health insurance return handsome dividends.

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[30] Acting Chief Engineer, State Department of Health of Pennsylvania.

Emphasis is placed upon the value of water purification as a factor in the reduction of typhoid fever. This is a rational position, for the public water supply is the only commodity that is ordinarily used in common by an entire community. The results of its infection by the typhoid organism will therefore be greater than a similar pollution of milk, uncooked vegetables, fruits, oysters or other food stuffs pointed out as occasional paths of transmission, but which are used only to a limited extent, and in the average community are obtained from many sources, which fortunately for the most part are free from contamination. A study of many recorded epidemics occurring in scattered communities throughout the country indicates that practically without exception every one which included a great number of cases was due to a polluted municipal water supply.

The public at large now generally realizes the danger of grossly and visibly polluted drinking water, and fortunately a large proportion of such supplies, either through the exercise of law or the weight of popular sentiment, has been properly protected or purified.

The next step is to safeguard the public health in communities where the water supplies are obtained from sources which are generally considered to be above suspicion. Many cities repose in fancied security because the source of the water supply is described as a "pure mountain stream", rising perhaps in some state or federal forest reserve or in a section of country containing only a few scattered habitations and rarely traveled public roads above the point where the stream is turned into the head of the supply line. As our knowledge increases we are awakened to a realization of the dangerous possibilities of such supplies. A single hunter, fisherman, berry picker, or chance traveler passing over the watershed, or the occupant of an isolated farmstead, a forest ranger's cabin or a temporary camp, if he happens to be in the incubation stage of typhoid fever or a convalescent from the disease may by careless disposal of excrement be the cause of a widespread epidemic sweeping through the entire community and resulting in many deaths. Large epidemics have been recorded due to such remote causes as the discharge of typhoid infected sewage into a stream from the toilet on a passenger train passing over the watershed from which a public supply was drawn.

Careful and conscientious patrols of watersheds at frequent intervals, the installation of proper sanitary conveniences at all occupied habitations, the posting of prominent notices warning the public against causing a contamination of the stream and the closing of toilet rooms while the trains or trolley cars are passing over the watershed have a certain value in safeguarding the supply. Such measures, however, because of their manifest shortcomings, can only be viewed as temporary expedients to be followed at the earliest possible date by the installation of a positive and adequate method of purification of the water.

The statement has been made on several occasions that every public water supply taken from surface streams must be viewed with suspicion unless purified by filtration or by depopulation, patrol and protection of the watershed combined with purification of the water through natural agencies brought about by long time storage in properly designed reservoirs. At first thought this statement appears unreasonable, yet careful consideration of the many possible sources of contamination of the usual water supply derived from upland streams demonstrates that it represents a sound and justifiable view.

As pointed out by the author, the eradication of typhoid fever will require much more than the purification of the public and the protection of private sources of water supply. Every method of warfare known to sanitary science must be brought into action against the spread of the disease, such as treatment of municipal sewage and proper disposal of that from habitations in the rural districts, protection of milk and other food supplies and many other precautions including those of prime importance, the isolation and proper care of the patient, and the conscientious and thorough disinfection of excrement, bedding, dishes, etc.

This general work must of course be performed by the local, state and federal boards of health. Disease does not respect the political boundary lines placed on a map, and unless checked will spread as easily over a county or state boundary line as throughout a single community, providing of course, that the channels for its continuation are present. Coöperation of the various protective forces is therefore necessary.

The magnitude of this general work in the rural districts is not thoroughly recognized. The population in these districts forms a considerable percentage of that of the entire country. Take Pennsylvania as an example, over 2,600,000 people, or approximately one-third the total population of the state, reside in the townships, where there are no regularly organized local boards of health. This number represents something over five hundred thousand separate dwellings, most of them with individual water supplies and separate methods of sewage disposal in other words, one-half million possible avenues for the spread of water borne disease. The purification of a public water supply, the construction of a proper sewerage system and the installation of other general measures will place a protective barrier around the great number of residents in a city and may have an appreciable influence on the typhoid death rate for the entire state. To offer the same protection to an equal number of the rural population will necessitate the visiting of perhaps several thousand individual homes and the solution of as many separate problems in sanitation. The municipality has resources which can be made applicable to its problem beyond the means of the average dweller in the rural districts, and also the urban population have opportunity to derive the benefits of coöperative action. It therefore devolves upon some central controlling body, such as the state board of health, to awaken the countryside to its dangers and through friendly advice, and when necessary by the police power of the sovereign state to battle with the common foe. Pennsylvania found such procedure to be necessary and accordingly on the reorganization of the state department of health eleven years ago, provision was made for over 700 local health officers, who, under the direct control of the state, administered health affairs in the 1556 townships of the rural districts. This work has been carried on with great success.

The fight against typhoid fever is apparently a winning one, but to make the victory complete it will be necessary for every citizen of the country to realize his duty to his neighbor and his government, and to observe the health laws and regulations as well as those referring to criminal procedure or property rights.

MR. W. F. MONTFORT[31] (by letter): Making people better than they wish to be is difficult. When the red light district is abolished the inmates move to freer quarters. When the saloon is closed the express companies provide.

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[31] Consulting Chemist, St. Louis, Missouri

While there is nothing attractive or enticing about drinking impure water, using contaminated milk, and living in unsanitary conditions, these are not exhilarating nor pleasurable sins, the law of inertia holds for persons and communities; they continue in an habitual way unless acted upon by some outside force. Theoretically, perhaps, no one will endure a water or milk supply known to be impure; practically the source of an explosive outbreak of intestinal disease is brought to light only after the epidemic is well under way.

The data assembled by Mr. Johnson in his paper "The Typhoid Toll" in the June issue of the JOURNAL OF THE AMERICAN WATER WORKS ASSOCIATION, present a convincing argument for common-sense "preparedness" in sanitation. As usual, the people preached at are not in the audience. How to get a hearing with sinning communities before a crisis comes is an unsolved problem. Wisdom is not organized in the public behalf.

In the states of Arkansas, Illinois, Iowa, Kansas, Kentucky, Missouri and Oklahoma are 1280 water works of varying size; of the cities thus supplied 95 are represented by members in the American Water Works Association. That is, Mr. Johnson's data will directly reach 7.4 per cent of these cities, and the remaining 92.6 per cent (1185) will hear of it only by chance, if at all. While reference to his paper will appear in several engineering journals, this will probably not greatly increase the number of water works men who have access to the information; for the 78 pages of text and tables are too much for publication in full, and abbreviated statements will likely fail to convey the message adequately.

Yet typhoid fever costs the citizens of the United States about $150,000,000 a year; for 300,000 persons suffer, and 20,000 die from it annually, and every case of typhoid fever is due to somebody's ignorance or neglect. "For lack of vision the people perish."

It would seem good business to buy immunity from preventable disease rather than pay tribute in lives of much greater value than the price of saving them. Two years since Dr. Hurty, President of the State Board of Health of Indiana, inveighed against the public policy of disregarding human beings exposed to as deadly plagues while protecting non-human livestock against tuberculosis, cholera and other plagues. In 1914 Congress appropriated $500,000 for the prevention of hog cholera and refused a measly $5000 for the child's welfare bureau. In our own good state of Indiana we had in the general assembly a parallel to this strange performance. It provided that $25,000 should be expended for saving hogs, and $2500 for saving babies. And thus it was established that hogs are worth ten times as much as babies in Hoosierland. Why it was not made 16 to 1 was never explained. One might infer that in national, state, city and rural politics swine and other domestic animals had the suffrage rather than their owners.

Helping people to want better sanitation will be done in each community by some form of educational campaign. As part of such campaign a statement of an argument of which this is an abridgment has been sent to 450 men connected with water works in Missouri and adjoining states.

MR. JOHN C. TRAUTWINE, JR.[32]: Mr. Johnson has modestly called his paper "The Typhoid Toll". It might justly have been entitled "An Appreciation of the Principles of Human Government". We still suffer outrageously from typhoid, from flies, from dirt, from nuisances of all descriptions, perpetrated by the sovereign individual. On page 253 Mr. Johnson indicates the sufficient reason for this when he reminds us that the national government has no adequate control over the sanitary matters of the states, or the states over those of their cities, or the cities over those of their citizens.

All the medical and biological science in the world could not have transformed the Panama Canal Zone from a plague-spot into a health-resort, if it had not been that governmental science, backed by the strong arm of the 100,000,000 people of the United States, compelled the Zone people to do what was in their own interest.

The history of civilization is the history of the subordination of the individual to the community and of his coördination as a member of the community. It is the history of our progress from savagery toward that condition of paternalism which was deprecated by President Hill during the superintendential discussion over fire-connection rates, and of which public water supply is one of the most illuminating examples, a paternalism under which, to quote Mr. Hill, the community will do everything for everybody.

While we remain in the transition state between these two extremes—while we fall short of the inevitable and complete paternalism of the near future—we must remain content to devote mornings to the adjustment of inadjustable relations of meum et tuum, between insurance companies, municipalities, water companies, individual consumers, and all the other innumerable parties interested in the great game of grab; concentrating, like Bunyan's "Man with the Muck-rake", upon "the straws, the small sticks and dust of the floor", and neither looking up nor regarding, though one stand over us and proffer us a celestial crown.

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[32] Civil Engineer, Philadelphia, Pennsylvania.

Nations suffer from what they call their "victories", as well as from their defeats. Our worship of the "liberty" fetich, "the spirit of 1776," still blocks the way to freedom from worse oppressors by making us unwisely reluctant to entrust our health officials with those large powers and those large means, without which, in this day of intense specialization, they cannot serve us efficiently.

We are indeed willing to hire experts to teach ourselves and our children languages, living and dead, and dancing; to cure our bodies of disease and to purge our souls from sin; but we resent dictation from our own high-browed sanitary specialists, and permit them to be ham-strung by our ignorant representatives in the municipal legislature.

We are unwilling even to entrust our highly paid Executive Committee with so simple a matter as the selection of the place of holding the next annual convention. We prefer to spend a precious Convention hour or two in balloting and eloquence, after the local patriots of the rival cities have spent months in lining up their forces, and days in plastering the walls of the convention place with "scenery".

We have not yet learned to realize that the moneys we pay out in taxes yield us far greater returns than do any private investments, and we therefore imagine we are clever when we keep down the tax rate by starving the health man.

Thus far our fear of officialism has been justified by the persistence of a "business" system which puts its premiums upon self-seeking. The community is the easiest of all easy marks, for no man is interested in caring for its welfare, or realizes that he is so interested, and we naturally distrust those who have got into positions where they seem to have access to the public purse. Who wonders that Mr. Maury's conscientious reservoir contractors have gone out of business? The honest man gathers no moss. And yet, democracy is not necessarily inconsistent with the concentration of proper authority in expert hands. Imagine a democracy, intelligent enough to recognize its own limitations, and virtuous enough to avow those limitations and to insist that its technical works shall be placed, *and left,* in the hands of well paid experts, untrammeled by popular ignorance and meanness. Such a democracy would be that best of all possible governments, a despotism under a good despot.

The Philadelphia city charter, granted nearly thirty years ago, recognizes the true principle, in that it places the city's public works "under the direction, control, and administration of the department of public works", and commands the city legislature to "provide for the proper and efficient conduct of the affairs of the city by the mayor and several departments, and the boards thereof". It also explicitly forbids their honorable bodies to "pass any ordinance directing or interfering with the exercise of the executive functions" of the mayor and his executive subordinates. The fact that these provisions have remained, and that they still remain, a dead letter, seems to throw doubt upon the gain accomplished when a community or its representatives are persuaded to adopt measures long before the people are educated up to such measures.

During a recent discussion, two interesting myths were mentioned. One of these was "the non-invasive individual", the individual who does no injury to society. The other was "our home as our castle". That there is no such animal as a non-invasive individual is only another way of putting what was written at least some twenty centuries ago, "No man liveth to himself alone." With every breath we draw, and with every thought we think, every one of us is every moment and inevitably invading the community. If our homes are indeed our castles, their walls are of a glass transparent to such invasion, which passes freely through them, both ways.

It would be rash to set bounds to that socializing process which forms the most notable feature of our modern life; but it may be interesting to glance at a short and nearby arc of its curve. A century ago, the supposedly non-invasive individual was left free to wreak pretty much what damage he pleased upon the community, and thus upon himself. Today, and quite without his realizing it, he has become subordinated to a despotic community control against which our patriotic forefathers would have rebelled as strenuously as they rebelled against George III. The city dictates to us the maximum heights of our buildings and the method of their construction. It even dares to suppress the God-given right of every redblooded American to expectorate upon the sidewalk. And yet we have barely scratched the surface. Fifty years from now, our successors will stand aghast at the recital of the outrages which the individual of today is still permitted to perpetrate upon his fellows, and will refuse to believe that our horror of "tyranny" could keep us until 1916 before we could realize the duty of a city to restrict its different lines of "business" within prescribed "zones", as New York is now beginning to do. They will accept as matter of course social domination which to us of today would seem as outrageous and as ridiculous as interference with spitting would have seemed to George Washington.

Mr. Johnson's paper blazes the way of progress.

For better, for worse, our people are not Panamans. They would reject the suggestion that they should submit to their own control as they imposed it upon the Canal Zone; so they must be content to grow healthy more slowly. Sanitary engineers in the United States have not yet the powers of army officers. They must gradually acquire the needed power, by demonstrating, as opportunity offers, their worthiness of it. Happily, "the(m)asses" do eventually learn by experience. Take, for instance, the filter and the water meter. These are useful as illustrations of the process, and as entering wedges for its operation. Like Mr. Goodrich's underground fire-hydrants, and everything else new, they are of course unpopular where they are unknown; but where the engineer has succeeded in placing them, they are warmly appreciated, the engineer has grown in the public confidence, and the way is thus opened for his acquisition of control in other directions.

Inertia, which governs in social as well as in physical matters, forbids sudden and radical changes. We cannot all become rational beings by a somersault; but, in this quieter and less spectacular, if also less heroic, way we are creeping on toward the ideal government, a benevolent despotism.

Commenting upon harmful interference, by state boards, with designs for local works, and upon delays caused by the deliberateness of such boards in passing upon such plans, Mr. Johnson suggests that state boards be relieved of the duty of passing upon plans, and that their function be restricted to that of seeing that proper results are obtained. The writer leans to the view that the true remedy is rather the reverse of this, viz., to secure higher-class timber for the state boards, and to charge them, not merely with criticism, but with the creation of local designs; for our small communities often have not the means to secure, even if they have the ability to select, the best engineering talent. Better still, let us hope for the day when state boards shall be no more, and when our engineers of the highest class shall be found coöperating in a national or even in an international board, charged with the design and construction of the works for all the water supply units of the nation or world, and of coördinating them into a national or a world water-supply system.

Dr. Peter H. Bryce[33] (by letter): Mr. Johnson's paper "The Typhoid Toll", which has brought together in convenient form for reference the main facts dealing with the enormous losses from this endemic disease both of life and of wealth, has been carefully read by the writer. A phase of it may very properly be still added to such figures, viz: the losses due to the diseases which are the sequelae of this intensely exhausting disease. Remembering how many cases of tuberculosis infection exist and remain quiescent during good health, yet which spring into activity during an exhausted physical condition due to many causes and to none more than to typhoid, the total typhoid toll could be very greatly enlarged. Fortunately we now know not only the cause, but also the chief means of preventing this disease, which ought to be as extinct as cholera is in Europe and America. The writer finds, however, in the various fields of scientific and social effort which his work brings him in touch with that there is great need everywhere, not only of refining our knowledge as to causes, but also for enormously increasing our appreciation of personal and municipal as well as governmental responsibility of the possibility and of the duty laid upon us of taking adequate steps to stamp out the diseases of this sort. Mr. Johnson's paper ought to serve very greatly to bring home to many persons their duties and responsibilities. Dr. Herman Biggs' maxim, "Public Health is purchasable. Within rational limitations a municipality can determine its own death rate," is constantly recalled.

Mr. Joseph Race[34] (by letter): The cost of the typhoid toll on this continent is necessarily based on the typhoid death rate and the case mortality, and in Table I various data are given which are based on 15 cases to each death, or a case fatality of 6.6 per cent. Although this figure may be somewhat lower than that usually accepted, it is even higher than the case fatality obtained in the Ottawa epidemic of 1912. As there are some unusual features in connection with this epidemic a few details might be of interest. The midsummer outbreak of 1912 followed a midwinter outbreak of over 1000 cases in 1911, population 90,000, and 1309 cases with 87 deaths were reported. The case mortality based on these records was 6.64 per cent, but when the city in the following year took the unusual course of voting $100,000 for the alleviation of suffering caused by these epidemics, further cases were reported, and after investigation 150 cases were added to the health department's records. This addition reduced the case mortality to 5.96 per cent. Even this figure is high compared with the average mortality in the two emergency hospitals of 5.02 per cent. The average duration of hospital treatment was 29 days.

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[33] Chief Medical Health Officer, Province of Ontario, Canada.

[34] Bacteriologist Health Department, Ottawa, Ontario.

In connection with Table 7, in the following table the percentage reduction in death rate for each month is calculated.

MONTH	TYPHOID RATE PER 100,000		PERCENTAGE REDUCTION	SIX MONTHS AVERAGE
	1910	1913		
December	16.6	11.9	21.7	
January	15.0	7.5	50.0	
February	14.8	7.7	48.0	
March	16.4	7.5	32.7	
April	12.8	7.2	43.1	
May	11.7	9.8	16.2	35.4
June	12.4	9.8	20.9	
July	13.9	13.4	+3.6	
August	22.5	17.4	22.7	
September	29.3	19.2	34.5	
October	25.2	22.1	12.3	
November	22.6	16.4	27.4	19.0

These results show that it is the winter typhoid that shows the marked reduction and especially the incidence occurring during the months when the water temperature is at a minimum. If this reduction is attributed to an increased supply of filtered water and to improved methods of purification, and if, as is usually the case, the B. coli content in the water supplies of these particular cities is lower in winter than in summer, additional evidence is afforded of the difference in the ratio of B. typhosus to B. coli in various seasons. The viability of B. typhosus is well known to be higher in cold water than in warm and yet sanitarians are attempting to establish rigid B. coli standards which take no account of this and other important factors that govern the ratio of B. typhosus to B. coli.

MR. GEORGE W. FULLER[35] (by letter): Mr. Johnson's paper is one of unusual interest and importance and it will doubtless be referred to frequently for some years to come. The main lessons pointed out by it are well founded and not subject to material criticism. Nevertheless, his paper will produce different impressions on various readers, depending upon their personal viewpoint and experience.

Bearing in mind that it is scarcely thirty years since the germ theory of disease reached general recognition, even among the medical profession, and that modern water filtration plants have been in vogue for scarcely half that period, perhaps the most impressive item set forth by Mr. Johnson is the substantial accomplishment of municipal water purification plants in reducing the typhoid toll. As municipal affairs shape themselves, by and large, in this country, it is perhaps not so much a wonder that typhoid fever still prevails to the needless extent that it now does, as is the fact that it has been reduced as greatly as has been the case through various agencies, principally that of modern water purification plants.

As to the circumstances which have been associated with the installation of water filtration plants, it is certainly fitting to speak a word of commendation for the sound, far-seeing judgment of those who have dominated the policy of privately owned water plants whose accomplishments in the purification field, particularly in the early days, was most praiseworthy.

Mr. Johnson very properly deals in his paper with corrective steps yet to be taken to effect further reduction in the typhoid toll. Water purification is a very important factor, but it is not the only one. So far as relates to public water supplies of conspicuously unsatisfactory quality, perhaps the bulk of the population now getting such water are residents of cities of small or moderate size.

How to bring about needed sanitary improvements in the public water supplies of small or moderate-sized towns and cities, particularly those municipally owned, and how to promote this proposition so that it will occupy an advantageous relationship to various other demands upon the public purse, is certainly a pertinent theme for discussion.

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[35] Consulting Engineer, New York, N. Y.

Those in responsible charge of water works plants are not so much in need of education upon this point as is the public in the communities in question. Education of the general public, and in this way the control of public opinion, is probably the factor which needs most earnest attention in the reduction of the typhoid toll.

This question needs consideration from a broad viewpoint. The water works official who declares year after year the need of betterments to improve the quality of the water supply soon finds that he is telling an old story, and to engage public attention is in urgent need of new ideas in which to dress plain vital truths.

There are some who have suggested that the water works people have a narrow viewpoint and are not disposed to investigate public health questions on broad lines and to prepare themselves for discussing to a logical conclusion the relative merits of different steps involving public expenditures.

Broadly stated, there is need of discussion in the interests of the public health of the procedure which for a given investment will produce the greatest public benefit. To say that a water supply of unsatisfactory quality must be improved does not get the project very far at the present day. These questions should be looked upon in a rational and comparative sense, and the water works men should not be backwards in taking their place with adequate equipment in the field of molding public opinion.

For the water works men to say that it is not important to have district nurses and visiting housekeepers to teach public and private hygiene in households where such information is not acquired by custom, books, pamphlets, or papers, is idle talk. Water works men ought to join actively in public welfare movements and be prepared to see that water supply matters, as related to typhoid and other diseases, are kept on a proper basis, but not to the exclusion of other channels through which human life is subjected to sickness and death. In that way public water supplies are likely to be placed with a minimum of delay on a basis of proper relationship to the still further reduction which is needed in the typhoid toll.

If this comprehensive paper, with its statistical citations of facts and moderate interpretations, serves no other purpose than to stimulate water works men into acquiring a broader, firmer and more effective viewpoint in the treatment of public welfare questions, the author may feel more than repaid for his task in writing this paper.

Mr. George A. Johnson (closing discussion): The author has been immensely gratified by the hearty interest displayed in the subject matter of his paper, and wishes to extend his sincere thanks to those who contributed to the discussion.

It seems to be the consensus of opinion that education, and still more education, is what is needed most of all, for, as Mr. Hering well says, "an ignorant citizen by a single foolish act can do more mischief than many officers may be able speedily to remedy". The efforts which are being made in this direction by the United States government, directed particularly at the education of the rural classes, are succinctly described by Dr. Blue. The viewpoint of philanthropic organizations such as the Russell Sage Foundation, is well expressed by Mr. Schneider.

Professor Monfort has poignantly said "For lack of vision the people perish". What truer words could be said of the typhoid situation in America today? As Omar remarked, "Heaven is but the vision of fulfilled desire"; so education is the promise which will bring fulfillment in better health conditions.

The insensibility of the public, reflected in the acts of the legislative bodies of our country, was never better demonstrated than in the action of Congress in 1914, when an appropriation of $5000 for the child's welfare bureau was refused, and one for $500,000 for hog cholera prevention was granted. Dr. Hurty, president of the state board of health of Indiana, pointed out a dismal parallel to this in the provision by the general assembly of that state of $25,000 for hog cholera and $2500 for the conservation of the health of children. Dr. Hurty then said: "Thus it was established that hogs are worth ten times as much as babies in Hoosierland".

Mr. Vogelson says that "Dividends must not be obtained by any risk of safety", and yet, as Mr. Ellms remarks, the axiom 'Money saved is money earned" apparently finds small favor with the American public. In this enlightened era the people of the United States, through "lack of vision", submit to an economic loss from typhoid fever many times in excess of the cost of preventing it.

It is not that we do not know how to prevent it. Dr. Freeman has said: "Our methods are certain, and will yield the desired result in every case where they are properly applied. The problem is no longer investigative or scientific, but a problem of administration. The solution of the problem is how to convince the American people that protection from typhoid fever is something worth spending money for".

The author is in hearty accord with the views expressed in the discussion relative to educational campaigns. Men of international repute such as Dr. Wiley and Dr. Evans are especially well qualified by ability and position to spread the gospel of sanitation among a host of people who do not read the technical journals. Their splendid work in this field is widely acknowledged. The same idea might well be taken up by the American Water Works Association, as Mr. Saville suggests, through the creation of a committee on education and publicity. As Mr. Vogelson truly says, "The attainment of the desired end is through a thoroughly awakened civic conscience, which will not permit the doing of those things which are harmful to public health".

The legal aspects of better sanitation are all important. Standardization of health laws, in order that their meaning may be clear and direct, and their interpretation easy, is highly necessary. Mr. Hansen's view is that "a health department should educate its public to the need of the law before attempting to introduce the law." Well, it is true that we live in a democracy wherein it may be that the government cannot be ahead of the people; but if so it probably is to the detriment of the public. The author firmly believes in education, but also believes in the law and its enforcement. There are a few people who know what is best for the public welfare, and it is for them to direct the footsteps of the majority. The public should be led, but if it will not be led it must be pushed. Ignorance of the law, we are given to understand, is not considered a legal excuse for its violation. Similarly, ignorance of the causes of disease is no valid excuse, especially where the disease is preventable through the observance of really simple measures of precaution.

Of what consequence would be an army without a leader? The private soldier, the non-commissioned officer, the lieutenant, the captain, the major, the colonel, all do as they are told to do. The general staff directs, knowing all the confronting conditions which those under their charge cannot know. It is so in public life. Organization and system, based on knowledge and experience, should take precedence over anarchy and what Burke referred to as "The Rights of Man".

The fourteenth amendment of the Constitution of the United States provides against abridgment of the privileges and liberties of citizens. This same fourteenth amendment is one of the hardest nuts the framer of sanitary laws has to crack. His purpose is to protect the public against itself, but in so doing he frequently runs counter to the average citizen's idea of what constitutes his privileges and liberties. Herein lies one of the chief fields of usefulness of public education, for, as the Court of Appeals of the District of Columbia recently said:

> Public opinion, keeping pace with advancing civilization, is the progressive factor which calls for an enlarged invasion of private rights for the public good, and which prompts courts to give greater elasticity to constitutional limitations.

The author's statements on pages 271, 272, relative to the manner in which water improvement projects are often handled by state boards of health, were made particularly with a view to encourage discussion of a subject which certainly deserves not only discussion, but action. With such matters handled as they now are often handled, the author contends that questions of approval or disapproval of improved water supply projects should not always come to final rest in the state boards of health.

In the discussion Messrs. Evans, Hansen, Hazen, Horton, Morse and Vogelson disagreed with the author with respect to his unnecessarily abbreviated thought as to guarantees of efficiency being sufficient to warrant acceptance of a water purification project. The author is forced to the confession that he purposely resorted to ambiguity in this reference, hoping that it might thus elicit extended discusssion of possible remedies for the existing unsatisfactory conditions.

Dr. Evans thinks the community will want the advice of experts in addition to guarantees. The author heartily agrees with him, for by "experts" Dr. Evans clearly means men qualified by knowledge and experience to pass upon such subjects. Mr. Vogelson is worried over the Patent Office files, but what the author knows of filter patent matters impels him to refuse to become frightened over this aspect of the matter. As to Mr. Vogelson's other point, namely, the problem of correcting defective work at the taxpayers' expense once it is built, the author is prone to consider as a parallel objection cases where incompetent health board engineers pass inappropriate work, which later on requires remodelling and rebuilding, or where they require needless elaborations in well conceived plans.

Mr. Hansen wonders what "tangible guarantees" may mean. The author used the term in its precise meaning, i.e., *tangible*, capable of being possessed or realized; such that one can lay the hand on it; within reach, real, as tangible security.

In issuing a certificate of approval of plans and specifications covering a given project it is the usual custom for the state board of health to tie a string to such approval in the form of a proviso that after the plant is placed in operation, if it does not give the results expected or required by the board, suitable alterations or additions must be made in order that it may do so, otherwise, the certificate of approval is invalidated. This puts the efficiency of the plant up to the operator, and no plant, however capably designed and built, can long give a good account of itself if it is turned over to the tender mercies of an inexperienced or careless operator.

This proviso, which forms an integral part of practically all certificates of approval issued by state departments of health, is in the precise nature of a tangible condition.

Mr. Hansen is correct in that the engineer does not guarantee his work, any more than a surgeon, reducing a bone fracture, gives a guarantee that the limb will set straight and sound. He may have no immediate control over his work after he leaves it. But the contractor is required to give guarantees respecting the stability of his work, even in cases where the design is the work of another engineer.

A case in point where a water filtration plant was built under a "tangible guarantee" was the contract entered into in 1907 between the Union Stock Yard Company of Chicago and the Norwood Engineering Company. The contract stipulations were that the raw water supply should be taken from foul Bubbly Creek and purified in a plant to be built by the Norwood Engineering Company. It was specified that the purification plant should be capable at all times of delivering an effluent "applicable to all uses for which the city water is applicable". It furthermore was stipulated that the cost of producing this water should not exceed $20 per million gallons. The contract specified four separate test periods, so that if the plant failed at first such changes as the contractor desired to make could be effected and another trial made. This could be repeated three times. The period of each test was to be a maximum of two weeks. The author was referee on these tests, during the first three of which the engineering company failed in some manner completely to fulfill the guarantees. In the fourth and final test period it succeeded, the plant was accepted and the contractor paid in full.

Now there was a penalty attached to this contract. In the event of failure to fulfill the guarantees, not only would the contractor lose what money he put into the construction of the plant, but he would be compelled to remove the unsuccessful plant from the grounds of the Union Stock Yard and Transit Company. If a private corporation can exact such conditions and a company comply with and satisfy them, the author submits that any city can just as well do so. The operations of the plant were watched not only by the contracting parties but also by the health department of the city of Chicago.

This is what the author meant when referring to "tangible guarantees". It is believed that no reputable filter manufacturing company would hesitate for a minute to guarantee not only the structures they erect but also their ultimate performances conducted under the direction of trained operators. If they are called upon to guarantee the stability or performance of works designed by others than themselves they unquestionably should have the right to modify such construction details as they deem important. Furthermore, in the tests to establish the efficiency of the plant in operation, they should be given the power of approval of the operating staff.

A city making such a contract under "tangible guarantees" would thus be protected in every important way, especially if cost factors, including the cost of construction and the cost of operation and maintenance were limited. Then it would be up to the state department of health to see to it that the plant is properly operated to yield an effluent of the desired degree of purity.

It is the chief duty of state health departments to furnish the public with the maximum of protection with respect to the purity of its water supply, as in all other matters relating to health and comfort. Thoroughly well conceived, adapted and constructed works are no more fool proof than works which are poorly conceived, adapted and built. Thus is made plain the paramount necessity for good operation of water and sewage works obtainable through the effective supervision of operation of such works by competent state health officials. The health department should constitute a strong connecting link in the chain of protection between the purification works and the public.

Where matters affecting the public health are under consideration the interested community is entitled to receive the best advice, the best service, the best protection that is available. The author's thought is that, failing to get a state board of unquestionable competency, which readily can be done if appropriations are adequate, the opportunity should in some approved manner be taken away from unqualified health departments to condemn, to modify unfavorably, or to hold up designs and construction indefinitely, where such work is under the charge of competent, experienced men. The worst that can be said of this suggestion is that it tends to a choice of the lesser opportunity for evil.

To fill his position completely and well the state board of health engineer, whose duty it is to scrutinize and pass upon the plans and specifications of his brother engineer in the open field, must be quite as good an all round engineer as those upon whose work he is passing judgment. The author submits that quite often the state board of health does not rise to this standard.

It is by no means improbable that there have been, and will be, occasions where a state board of health engineer may properly criticize, and advantageously criticize, the work of a practicing engineer of long and varied experience. Fundamentally, though, it would appear that the average practicing engineer is more likely to be right in principle than the average engineer of the state. His experience covers a wider field. A failure on his part is a distinct setback to his future prospects, and he cannot afford to take chances. He gives the best he has.

The author hopes he may be forgiven if he says that his observation has taught him that all men are prone to ride a particular hobby, or set of hobbies; but it has also taught him that an engineer designing an important public work is mighty careful to protect his reputation first by good, safe, substantial work before he ascends to the back of his hobby. The author cannot say that as a rule the engineers of state boards of health labor under this moral restraint. He admits that so far as their knowledge and experience will carry them they may be relied upon to take no chances; but they often may be expected to display a generous inclination to "play safe" through the demand of certain elaborations in a design which are not justified, and which financially burden the community unnecessarily.

In order to fill these highly responsible positions competently such representatives of the board must have had wide experience, not only in designing work, but in the construction and operation of such plants. Without such specific experience there is a strong tendency for the state engineer to particularize on those features with which he is most familiar, and to lose sight of the broad conception which is taught only by extensive experience. Desk work will not furnish this knowledge. On the other hand, lack of broad experience in such matters may cause him to treat such questions in a somewhat perfunctory manner, and to generalize where his knowledge does not qualify him to generalize. Both of these methods are bad, one probably as dangerous as the other.

With eminent dispassion the author submits that strangely enough the general public, including the engineer, has come to view the average state board of health in the light of a quasi-celestial body, whose infallibility is certain, and whose impeccability is unquestioned. Such boards have become a sort of court of last resort in health engineering matters, and while no one would more heartily welcome the warranted mundane apotheosis of state boards of health than the author, the plane of efficiency of many such boards must be raised materially before he would be willing to grant them the unquestioned right to the broad exercise of such arbitrary power. The solution of the problem is one wherein the interested community and the engineer, as well as the state board of health, will obtain full equity and strive together to win a common goal. That condition does not now prevail.

The author submits that the requisite end would be attained if every state had a health department wherein the engineering division would be manned by well paid men who, by actual work under a wide variety of conditions, and extending over a period of years, would thus be qualified to pass upon details of design of water filtration and sewage disposal projects, having a clear conception in their minds' eye while they were studying such designs of the kind of service such works would give if built and placed in operation.

As matters now stand, whether competent or not, the rulings of state departments of health are usually accepted as final. Furthermore, whether the law under which they act gives them the power of approval and rejection, the mere withholding of a decision often furnishes enough ammunition for those opposed to a project to defeat it.

Replying particularly to Mr. Morse the author would state that it is by no means his thought that all water purification projects are amenable to the tangible guarantee idea, or that such a procedure is necessary, or even desirable, in all cases; but he does think it points the way to a remedy under certain sets of circumstances and conditions. He is in full sympathy with Mr. Morse on the proposition that in cases where a community is unwise enough to employ inexperienced engineers to lay out its work a review of such projects by the state department of health is more than ever necessary. And yet the main point still persists; it is then vitally necessary that the health department engineer shall know his business.

The author wishes to assure Mr. Morse, and the engineers of all state health departments, that his apparent strictures on this general point are intended more as a statement of broad conditions as they exist than as a criticism of the engineers themselves. He fully agrees with Mr. Morse that, having suitable laws, capable men should be employed and given ample appropriations and powers to carry them out; and that these men should not only be capable but fair and broad minded.

The author realizes all too well that up to this point his argument has been preponderatingly a destructive one, yet it is sometimes well to be somewhat iconoclastic, and in view of all the well known, but heretofore carefully avoided facts, it would appear very wise, indeed very necessary, to apply iconoclastic doctrines to state departments of health as many are now constituted, and as many now operate. The solution doubtless is to be found in a constructive policy, in the line of improvement in the personnel of such departments. This can only be effected with benefit through larger appropriations and the selection of men qualified by experience to hold these highly responsible positions of authority.

The author thinks highly of Mr. Hansen's suggestion relative to the amendment of public health laws so that "any municipality, corporation or institution which has occasion to submit plans to a state board of health, and which may not regard the requirements of the board as correct or just, can demand a reference of the matter to a commission of expert sanitary engineers to be appointed and employed jointly by the state board of health and the party taking exception to the board's orders". This amendment might well be made to the public health laws of all states.

Mr. Hazen thinks it will be some time before it will be necessary to filter all surface waters to make them safe for human consumption. Mr. Vermeule also has something interesting to say about how the typhoid fever death rate has been lowered in some cities through improvements in the water supply other than filtration. Mr. Emerson has made some pertinent observations on this point which will bear careful reading.

The author knows that some cities in which the general health conditions are excellent, and typhoid a comparatively rare visitor, take their water supplies from surface sources and do not filter them. His view is, however, that no catchment area is so remote and inaccessible to travelers that it may not one day become dangerously polluted; and that no matter how pure a surface supply *ought to be*, because of the isolation of its source, positive assurance is lacking that it *may not* become polluted by accident or chance. To avoid that chance by filtration is certainly worth 40 cents per annum to any man.

Nevertheless, there is a world of truth in Mr. Hazen's statement that "When you get a water supply up in the Cascade Mountains it is going to be some time before the people will put up money to filter that water". There have been many notable cases among the large cities of this country where it was many years before the people put up money to filter supplies which were known to be foully polluted. Consequently, in this day, when it is a case of filtering a supply which is only *open* to pollution, like that of New York from the Catskills, the reluctance of the public to pay for absolute protection is quite as great. The author thinks, however, that Mr. Hazen was giving expression to the public mind more than to the inner convictions he doubtless holds on the matter. Even in the field of water sterilization, of which Mr. Hazen speaks so favorably, while freely admitting that it has worked wonders in typhoid reduction, it must not be forgotten that to sterilize an unfiltered water so as to obtain absolute protection is often a very difficult, if not impossible, undertaking. Sterilization of filtered waters will accomplish this end.

The author has read with great interest the instructive views of Messrs. Miller, Tribus, Curry and Pollard relative to public health education, and is entirely in sympathy with the ideas they express.

Mr. Brown calls attention to a most important point in connection with the management of water filtration plants. Why is it that so many cities fail to profit by the good example set them when their new plants are undergoing an efficiency test? As a rule high grade operators have charge of the plant at such times, and high efficiencies result; then it not infrequently happens the city places a vote collector or a cheap and inexperienced operator in control, and blames the contractor or designing engineer because the plant falls down.

What can be done by "taking account of stock" in a state health department has been well described by Mr. Horton. The statistics appear to leave little, if any, room for doubt that the widespread purification of municipal water supplies, and the close watch set upon them by the health department, have resulted in a reduction in the typhoid death rate in New York state of 67 per cent in the last ten years.

In his discussion Mr. Jackson has added another sound piece of testimony to his already long list of incontrovertible evidence against the house fly as an important factor in typhoid transmission.

Mr. Baker's comments relative to the advisability of appointing sanitary engineers for local health board work are instructive. Everyone knows, or should know, what splendid history has been made in Montclair in the past twenty years. Other cities and towns might well follow the lead of Mr. Baker's home, the Town of Montclair.

The remarks of Mr. Hill, relative to the degree to which sewage should be treated before being discharged into public waters, are in general accord with the author's views, as already expressed in reply to a question put to him by Secretary Diven.

The warning voiced by Mr. Powers respecting the dangers coming from the excreta of travelers on railroads and steamships is one which is too often entirely ignored, largely, maybe, because it is an evil so difficult to curb. On steamboats it is practically impossible to do so, and on railroad trains the porter and his toilet key respond all too readily to the silvery voice of the common medium of exchange.

The living menace to the public health offered by the typhoid carrier is set forth by Dr. Soper in a solemn and impressive manner. He also calls attention to the fact that the author "merely mentioned what is pro ably the firmest defense which the individual can provide for himself, vaccination". That is true; but the author while admitting that anti-typhoid vaccination will do much toward eradicating the disease, realizes that if it is difficult to get people to filter their water it is even more difficult to gain their consent to be vaccinated. Dr. Park well says that "water is the chief danger"; and while many of us will avail ourselves of the ounce of prevention in the form of anti-typhoid vaccine, nevertheless, as Mr. Hering remarks, while "This expedient may become in time as valuable as the anti-smallpox vaccine, this expectation must not hinder us from imparting the education now practicable regarding the dangers that face us and how they can be avoided". Again, Dr. Wiley says: "It is not likely that all of us in the near future will be vaccinated against typhoid". *The remedy is in the control of the sources of infection.*

Filtration of public water supplies stands as the sure control of the chief source of all typhoid. In all great epidemics of typhoid fever, practically without exception, the most common cause is found to be the water supply. Since water is in common use by the community its effect, when impure, must always be greater and more widespread than that from impure food.

Dr. Evans and Mr. Saville were quite right in suggesting that the excellent results accomplished by making all privies flyproof have been duplicated at Richmond. Dr. Levy, in a letter to the author, called attention to the fact that Richmond was a pioneer in this line of sanitary endeavor. Proper acknowledgment should have been made by the author in the first place, for he has long been aware of the remarkable work done for Richmond by Dr. Levy and his associates. The typhoid reduction in that city during the past ten years is a matter worthy of unstinted praise. On a basis of low typhoid death rates Richmond stands today at the forefront of all southern cities, and ahead of many northern cities.

Dr. Chapin is quite correct in his statement that it is difficult for European health officials to comprehend the importance of water borne typhoid fever in the United States. But in European countries the public health laws are better obeyed than here; and they are profiting by the experiences which this country only now is going through.

Dr. Evans calls attention to the fact that the reader is liable to get an erroneous idea of the immunity to typhoid of people past forty, when studying Table 11 of the paper. To clear up this point table 35 has been prepared, and it is hoped that the data therein given will cover Dr. Evans' point. It will be noted from this table that the mortality rate from all causes is greatest before five and after sixty years of age, whereas the typhoid mortality is least at those ages, the greatest mortality occurring between the ages of ten and forty years.

TABLE 35

Mortality from all causes and from typhoid fever, according to age.

AGE	POPULATION OF REGISTRATION AREA		TOTAL DEATHS ANNUAL AVERAGE 1910-1913		DEATH RATE PER 100,000 POPULATION	
	Percentage distribution by age*	Total by age division	From all causes	From typhoid fever	All causes	Typhoid fever
Under 5........	10.2	6,460,000	214,142	617	3330	9.5
5 to 9.........	9.3	5,890,000	18,386	708	312	12.0
10 to 19........	18.2	11,540,000	32,836	2368	285	20.5
20 to 29........	19.0	12,040,000	65,618	3320	545	27.6
30 to 39........	15.6	9,870,000	72,634	1938	736	19.6
40 to 49........	11.8	7,470,000	77,397	1213	1036	16.2
50 to 59........	7.9	5,020,000	89,171	778	1776	15.5
60 and over....	8.0	5,070,000	273,864	667	5401	13.1

* Population of registration area in 1913 was 63,300,000.

In connection with this general point it is interesting to consider how the population in different sections of the country is made up by age groups. This is shown in Table 36. The noteworthy features of this classification are the marked superiority of the percentage of youthful people (below twenty years) in the southern states; and the sharp reduction in age percentages after thirty years. In the Pacific regions the relatively small percentage of inhabitants below twenty years of age is equally remarkable, as is the balancing effect of the relatively high percentages of the groups of greater age.

Professor Winslow is of the opinion that the susceptibility to typhoid is less in the case of those who bathe every day than in those of less cleanly habits. It would seem that this ought to be so, but the author still feels that there is a great deal in the immunity idea. Once inside the body a successful attack on the part of a typhoid germ depends upon the amenability of the subject. It may be that even in grossly unclean surroundings there is a preponderance of subjects who have become "toughened" to such things. It must

TABLE 36

Distribution of population by age.

AGE DIVISION	NORTH	SOUTH	MOUNT-AIN	PACIFIC	ACCUMULATIVE PERCENTAGE POPULATION BY AGE GROUPS			
					North	South	Mount-ain	Pacific
years								
Under 5	10.5	13.9	11.6	8.6	10.5	13.9	11.6	8.6
5 to 9	9.7	12.8	10.4	7.9	20.2	26.7	22.0	16.5
10 to 19	18.7	22.3	18.1	16.3	38.9	49.0	40.1	32.8
20 to 29	18.5	18.1	20.4	20.7	57.4	67.1	60.5	53.5
30 to 39	15.1	12.9	16.1	17.5	72.5	80.0	76.6	71.0
40 to 49	11.5	8.5	11.2	13.1	84.0	88.5	87.8	84.1
50 to 59	7.9	6.2	6.9	8.2	91.9	94.7	94.7	92.3
60 and over	8.1	5.3	5.3	7.7	100.0	100.0	100.0	100.0

be so, else every great typhoid epidemic would be more fatal in the congested districts. Mr. Vermeule has shown in his discussion how higher general death rates and higher typhoid rates sometimes hold true of the wealthier, and it is therefore to be supposed, cleaner classes. Nevertheless the author is very eager to accept Professor Winslow's conclusion that body cleanliness tends strongly to all around better health conditions.

Mr. Dittoe and Dr. Boudreau have described what Ohio is doing to reduce the typhoid toll, and the good work done is commendatory. Water filtration for 42 per cent of the population of the state has been the chief agency in bringing about the fairly low typhoid fever death rate which now obtains in that state. Health matters in general in Ohio have taken a wonderful brace in the past ten years, but much still remains to be done, for in the period 1910-1913, inclusive, Ohio ranked fifteenth as regards the typhoid fever death rate in the registration states, such large states as California, Massachusetts, Minnesota, New York, New Jersey, Pennsylvania and Wisconsin having a better record in this regard. The data presented by Messrs. Dittoe and Boudreau, descriptive of the work they are doing, are highly instructive.

In the state of Pennsylvania, as set forth by Mr. Emerson, the difficulties confronting the sanitarian are great. At present one-third of the population of the state reside in townships where there are no regularly organized boards of health. This condition is duplicated in Ohio, and unquestionably has as much as, if not more than, anything else to do with keeping the typhoid fever death rate in these two great states, which rank second and third in population among the states of the Union, as high as it is. The discussions of the officials of these states are very enlightening as showing the great need for rural sanitary work.

Mr. Trautwine's description of how well nigh ideal health conditions were brought about in the Canal Zone brings home forcibly the truth of what can be accomplished if the methods and means are all that they should be. This wonderful piece of sanitation will ever live as the supreme accomplishment of Dr. Gorgas.

Dr. Bryce's remarks relative to the loss of life and wealth through diseases which are the sequelae of typhoid fever are pertinent. This loss is great, how great none can say. The doctor's reference to the relationship of typhoid fever and tuberculosis, one growing out of the other through depleted vitality, certainly furnishes food for thought.

Mr. Race's comments relative to the somewhat unusual typhoid epidemics which occurred in Ottawa are interesting. The 1911 outbreak occurred in January and continued through the following April; and the 1912 epidemic started in July after a period lasting several months of almost complete freedom from typhoid mortality. The cause was polluted water in both instances, and serves as good proof that none can predict when an unpurified water supply will become infected with disease germs. Some day Ottawa may filter its water supply, but the usual procrastinating formulae probably will be followed through, as has been the experience in other great cities in North America, and the prehistory of the matter be well dotted with the red marks of the usual series of preventable water borne epidemics.

Mr. Fuller has mentioned the fact that perhaps the bulk of the population now having water supplies of conspicuously unsatisfactory quality are residents of small cities and towns. How best to educate the general public to the need of pure water in these smaller communities is not easy to say. It seems to the author that Mr. Fuller has described one important way when he says that water works men ought to join actively in general public welfare movements. It is possible that in this way, through the education of the public in the general causes and methods of prevention of disease, water purification promptly will take its proper place among the more important agencies of disease prevention, and thus be advanced with a minimum of delay.

In closing the author wishes to express his appreciation of the resolution offered by Mr. Gwinn and voted by the Association, directing the reprinting of this paper in pamphlet form for public distribution. He also desires to thank Mr. Trautwine for his efforts in preparing so excellent an abstract of the paper for use in the advance notice of the reprints. The author believes profoundly in Mr. Tribus' logic that "Even so vast in importance as is the subject, it will only be given due weight when public sentiment is aroused." Distribution of the paper and discussion in this manner may serve to carry the message into many dark quarters where light is urgently required.